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A TEXT-BOOK
ON
DISEASES OF
THE EAR, NOSE
AND THROAT

BY

CHARLES H. BURNETT, M.D.
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JAMES E. NEWCOMB, M.D.

WITH NUMEROUS ILLUSTRATIONS



PHILADELPHIA AND LONDON
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PREFACE.

THE close relation between the diseases of the ear, nose, and throat has rendered it desirable that there should be a conjoint text-book on these diseases and their treatment. This work has therefore been divided into three parts, each written by a practical teacher specially familiar with the subject on which it treats. The aim of the authors has been to present the anatomy and physiology of the ear, nose, and throat concisely, but with thoroughness and in accord with the latest discoveries in their respective departments.

In the treatment of the diseases of the ear, nose, and throat the authors believe that they have presented those methods of medication and surgery which are at once the newest and accepted as the best by the leading specialists in laryngology, rhinology, and otology. Each author is, however, responsible for only his own statements.

The editor desires to express his thanks to his associates for their prompt and untiring aid in the preparation of their parts of the work, thus enabling him to lay before the profession a treatise that he believes will be found helpful both to the general and the special practitioner of medicine and surgery, and particularly adapted to the needs of students by its concise and thorough presentation of the subjects within its scope.

CHARLES HENRY BURNETT,
Editor.

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DISEASES OF THE EAR.

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CHAPTER I.

THE ANATOMY AND PHYSIOLOGY OF THE AURICLE.

Embryology.—The auricle, or pinna, and the external auditory canal are formed about the first external branchial furrow. They belong, therefore, in their development not only to the inferior maxillary process of the mandibular arch, but also to the anterior portion of the hyoidal arch, where it borders on the posterior boundary of the first branchial furrow. The tumid edges surrounding the first external branchial furrow show a tendency to divide into a number of hillocks—the so-called auricular hillocks of Moldenhauer—about the end of the first month of embryonal life.

His describes six of these prominences. Two of them belong to the inferior mandibular arch and bound the anterior edge of the branchial furrow (Fig. 1, 1 and 2), and three are parts of the hyoidal arch, and are found along the posterior edge of the branchial furrow (Fig. 1, 4-6). Between these two rows, at the upper end of the branchial furrow, is found the so-called third hillock (Fig. 1, 3), or the tuberculum intermedium of His. Hillock No. 1 (Fig. 1, 1) of the mandibular arch gives off a small accessory hillock that participates as the tuberculum tragicum in the formation of the auricle, while the rest of the primary hillock region over-

FIG. 1.



Surroundings of the first branchial cleft, and neighboring portions of the face of an embryo of one month; left side magnified twelve diameters. (His and Schwalbe.) 1-6, His's auricular prominences; 1, tuberculum tragicum; 2, tuberculum anterius; 3, tuberculum intermedium; 4, tuberculum antheleis; 5, tuberculum antitragicum; 6, region of the lobule; l, auditory vesicle; c, His's cauda helix, or free aural fold of Schwalbe; helix hyoidalis of Gradenigo. Between the hillocks is the fossa angularis.

arches to some extent hillock No. 6 (Fig. 1, 6) and unites with it. The free portion of hillock No. 6 develops into the lobule of the auricle. Behind the three hillocks 4, 5, and 6 of the hyoid arch originates a parallel ridge that becomes the cauda helieis of His. The second hillock, or tubercle No. 1, forms the tragus, hillock No. 5 the antitragus, hillock No. 2 the crus helieis, and hillock No. 3 and the cauda unite to form the complete helix. The fourth hillock, the tuberculum anthelieis, finally forces itself forward within the helix and becomes the anthelix.

The furrow bounded by the auricular hillocks and extending in a dorso-ventral direction, with indentations between every two hillocks, is called by His the fossa angularis (Fig. 1). A transverse ridge, the central tubercle, in about the middle of its course, divides the fossa angularis into an upper and a lower portion, the latter finally deepening into the concha proper and the external auditory canal.

The Developed Auricle.—Fig. 2 represents the auricle of a new-born male child, with converging hairs on the highly developed Darwinian ear-point.



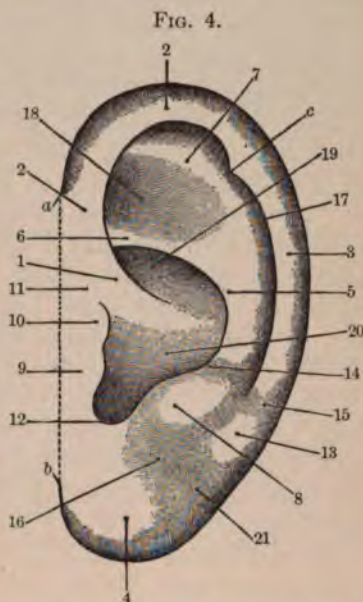
Fig. 3 shows the auricle of a woman with well-marked Darwinian ear-point. Fig. 4 shows the auricle of an adult man, with the Darwinian ear-point at *c*. This latter part in the auricle of man corresponds to the pointed ear of the lower animals. The auricle consists of a fold of the skin of the face reflected over a shell-shaped cartilaginous support, the various convolutions and surfaces of which it closely and tightly follows, passing inward with it into the cartilaginous part of the external auditory canal. The cartilaginous framework of the human auricle extends inward

at the concha into the porus acusticus externus of the temporal bone, and is united to the free outer edge of the osseous external auditory canal. It thus forms about one-third of the external auditory canal, the inner two-thirds being formed of bone. The cartilage of the auricle is furthermore held in place by ligaments and delicate muscles. Over the whole is reflected the aforesaid skin of the face, passing inward to line the external auditory canal as a dense, sensitive cutaneo-periosteal tissue, but extending over the outer surface of the membrana tympani simply as its very thin outer or dermoid layer. The outer surface of the auricle is, on the whole, a concave surface, whereas the surface turned towards the side of the head is convex.

The ligaments of the auricle are two in number,—viz., the anterior ligament of Valsalva, running from the root of the zygoma to the helix and tragus, and the posterior ligament, from the anterior part of the outer surface of the mastoid to the eminentia conchæ.

The muscles of the auricle consist of two sets,—viz., (1) those that arise from the vicinity of the external ear and are inserted into the auricle, and (2) those that originate from and terminate in the cartilage.

Skin of the Auricle.—The skin on the convex surface of the auricle is so connected by elastic fibres to the cartilage as to be somewhat movable upon the latter. On the concave or anterior surface the skin is bound firmly and immovably to the perichondrium. The distribution of fat also varies greatly. In the cyma conchæ, in the deepest portions of the concha propria, on the lower crus helcis, the apex of the fold of the anthelix, and inner surface of the tragus fat is entirely absent. There is, however, a sparse distribution of fat on both slopes of the fold of the anthelix in the fossa navicularis, the fossa triangularis, and in the rest of the territory of the concha propria. However, the subcutaneous connective tissue of the convex surface contains numerous fat racemes. Fat is especially abundant in the lobule. The epidermis and cutis of the convex surface of the auricle are similar to those of the neighboring integument. Delicate hairs with accompanying sebaceous glands, as well as small sweat-glands, are scattered over this surface. On the concave surface the skin is much more delicate, and the epidermis very thin. Papillary elevations in the cutis are few and low, and in some places scarcely discernible. Delicate hairs are found in those regions in which there is a deposit of fat. The hairs on the tragus, antitragus, and incisura intertragica are especially long in the male of advanced age. Associated with the hairs are sebaceous glands, well developed in the cavity of the concha. Comedones may form at these points. In the small plugs of sebum the so-called louse



Auricle of a man. (G. Schwalbe.) *ab*, auricular base; *abc*, auricular triangle; *c*, Darwinian point; 1, crus helcis; 2, ascending anterior upper helix; 3, descending posterior helix; 4, lobule of the auricle; 5, trunk of the anthelix; 6, inferior crus of the anthelix; 7, superior crus of the anthelix; 8, antitragus; 9, tragus; 10, supratragic tubercle; 11, anterior sulcus of the auricle (incisura tragohelicina); 12, intertragic incisure; 13, retrolobular tubercle of His; 14, posterior sulcus of the auricle (incisura anthelcis); 15, helicobulbar sulcus; 16, supra-lobular sulcus; 17, fossa navicularis, or scaphoidea; 18, fossa triangularis; 19, cyma conchæ; 20, cavity of the concha; 21, retrolobular sulcus.

of the hair-follicle is found. (Henle and Schwalbe.) Sweat-glands are wanting in the larger part of the concave surface of the auricle. At the entrance to the auditory canal modified sweat-glands occur as the ceruminous or ear-wax glands.

Arteries and Veins.—The anterior auricular arteries originate from the superficial temporal, and the posterior auricular branches from the posterior auricular artery. The anterior auricular veins anastomose with the superficial temporal vein. The posterior auricular veins anastomose by means of a net-work of veins behind the ear, emptying chiefly into the external jugular vein, but to some extent also into the posterior facial vein. The veins of the under surface of the cartilaginous auditory canal anastomose with that part of the aforesaid venous net-work in communication with the posterior facial. The veins of the auditory canal, the deep auriculars, originating from the bony canal and from part of the cartilaginous portion of the auditory canal, anastomose with the venous net behind the articular portion of the inferior maxilla.

Lymphatics.—According to Sappey and G. Schwalbe, the lymphatics of the auricle originate close beneath the epidermis in the papillary elevations of the cutis, the interpapillary spaces, and the neighborhood of the hair-follicles and sebaceous glands as a net-work of stellate and communicating lacunæ, from which arises a net-work of communicating lymphatic capillaries. From the latter originate the excretory lymphatics, which pass in three directions from the auricle,—viz., (1) the *anterior lymphatics*, from two to four in number, some passing from the concha and the external auditory canal and emptying into a lymphatic gland immediately in front of the tragus, while others arise from the fossa triangularis and the ascending part of the helix, pass around the edge of the helix to the convex surface of the auricle, and empty into the mastoid glands; (2) the *posterior lymphatics*, five in number, arising from the concave side of the auricle near the helix and anthelix; these pass around the edge of the auricle and empty into the mastoid glands; (3) the *inferior lymphatics*, from seven to eight in number, are developed from the lobule of the auricle and are distributed to the lymphatics within the parotid, lying immediately beneath the external auditory canal.

Nerves.—The motor nerves of the small auricular muscles arise entirely from the facial. The sensory nerves of the auricle arise from the anterior auricular branches of the auriculo-temporal nerve, and are distributed to the skin of the tragus and ascending helix. The rest of the auricle and the lobule are supplied by branches of the auricularis magnus of the third cervical. Neuralgia of the auricle in caries of the cervical vertebræ may be explained by recalling the innervation of this part of the ear from the auricularis magnus. It is well to bear in mind that very often the auricularis magnus contains filaments from the spinal accessory nerve that participates in the formation of the cervical plexus.

The facial branches of the auricularis magnus communicate with the

facial nerve; the posterior or auricular branches communicate with the auricular branches of the facial and pneumogastric, and the mastoid branches with the posterior auricular branch of the facial, and are distributed to the skin behind the ear.

The skin of the auditory canal is supplied by two branches of the auriculo-temporal nerve, the so-called internal nerves of the auditory canal. They enter the canal at the junction of the cartilaginous with the osseous portion of the auditory canal, the upper one being distributed to the membrana tympani as the membrana tympani nerve. A twig of the auricular branch of the pneumogastric nerve passes to the posterior wall of the osseous auditory canal, while another twig of the auricular branch of the pneumogastric communicates with the posterior auricular branch of the facial nerve, and is distributed to the medial or convex surface of the auricle chiefly, but it also sends a twig directly through the cartilage to be distributed to the skin on the concave surface of the auricle.

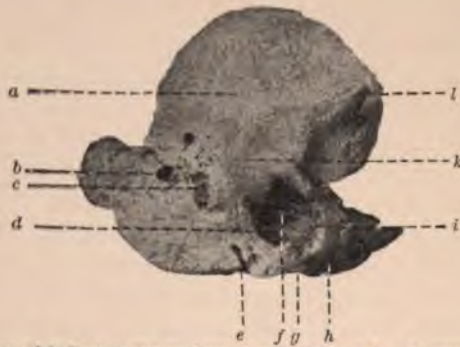
Resonant Functions of the Auricle.—The function of the auricle in man is, when added to the cavity of the auditory canal, that of a resonator adapted to augment just those high notes or sounds most likely to be of interest or importance to man. It is a fact that the auricle in combination with the auditory canal, closed at the bottom by the membrana tympani, forms a resonator of more or less conical shape, the special function of which is to strengthen waves of sound possessing a short wave-length.

CHAPTER II.

THE ANATOMY AND PHYSIOLOGY OF THE EXTERNAL AUDITORY CANAL.

THE temporal bone at birth consists of three distinct parts,—viz., the squama, the annulus tympanicus, and the petromastoid portion. The

FIG. 5.



Right temporal bone of infant, outer surface, from photograph. *a*, squama; *b*, *c*, natural dehiscences in the young bone; petrosquamous suture; *d*, *i*, annulus tympanicus; *e*, stylomastoid foramen; *f*, stapes in the oval window; *g*, jugular fossa; *h*, carotid foramen; *k*, outer wall of attic, so-called "acute;" *l*, zygoma.

squama (Fig. 5, *a*) and the petromastoid (Fig. 5, *b*, *c*–*h*) are the largest, while the small annulus tympanicus is applied to the outer side of the petrous

FIG. 6.



Inner surface of right temporal bone of infant, from photograph. *a*, inner surface of squama; *b*, petrous pyramid; *c*, entrance to Eustachian tube; *d*, carotid canal; *e*, position of jugular bulb; *f*, entrance to aqueductus vestibuli; *g*, lower back part of inner surface of pyramid; *h*, porus acusticus internus; *i*, subarcuate space beneath superior semicircular canal; *k*, ridge of petrous pyramid; *l*, petrosquamous suture.

pyramid (Fig. 5, *d*–*i*). A view of the inner surface of the infant's temporal bone shows only two of these original parts,—the squama and the

important petrosquamous pyramid (Fig. 6, *a* and *b*, *e*, *f*, *l*). A view of this same bone directly in front shows the three component parts of the bone in relation to one another,—the squama (Fig. 7, *a*, *c*), the annulus tympanicus (Fig. 7, *e*), and the petrous part (Fig. 7, *g*, *i*, *k*, *m*). A closer inspection of Fig. 5 shows the outer surface of the squama (*a*), its line of union with the petromastoid at *b*, *c*, its tympanic portion, or "scute," at *k*, descending to form the outer wall of the attic, and to unite with the annulus tympanicus, *d*, *i*; and at *l* is seen the zygoma. In Fig. 5, at *e*, is the stylomastoid foramen, at *f* may be seen the stapes in the oval window, and at *g* is the situation of the jugular bulb, beneath the floor of the drum-cavity. The latter and all its contents are the same size in the newborn child as in the adult; but not so the rest of the temporal bone of the infant.

The *annulus tympanicus*, in which sits the *membrana tympani*, is not a complete ring at birth, nor at any subsequent time. It is deficient in its upper eighth, its circumference being completed for support of the *membrana tympani* at this point by the



FIG. 7.
Inner surface of the right temporal bone of infant, viewed directly from in front. *a*, inner surface of the squama; *b*, zygoma; *c*, upper part of petrous pyramid; *d*, Glaserian fissure; *e*, annulus tympanicus; *f*, bony Eustachian tube, looking through the tube and tympanic cavity out of the annulus tympanicus; *g*, jugular fossa; *h*, carotid canal, exit; *i*, porus acusticus internus; *k*, subarcuate space; *l*, lower posterior surface of petrous pyramid; *m*, upper posterior surface of petrous pyramid.

FIG. 8 A.

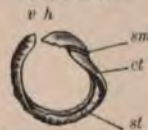


Outer side of the annulus tympanicus, left ear. (Politzer.) *a*, tuberculum tympani anterior; *p*, tuberculum tympani posterior.

tympanic process of the squama (Fig. 5, *k*). On the concave side of the tympanic ring is a groove for the insertion of the *membrana*, the *sulcus tympanicus*.

On the outer surface of the tympanic ring there are two enlargements, one on the front limb, the other on the posterior limb of the annulus. That on the anterior part of the ring (Fig. 8A, *a*) is called the anterior tympanic tubercle; that on the

FIG. 8 B.

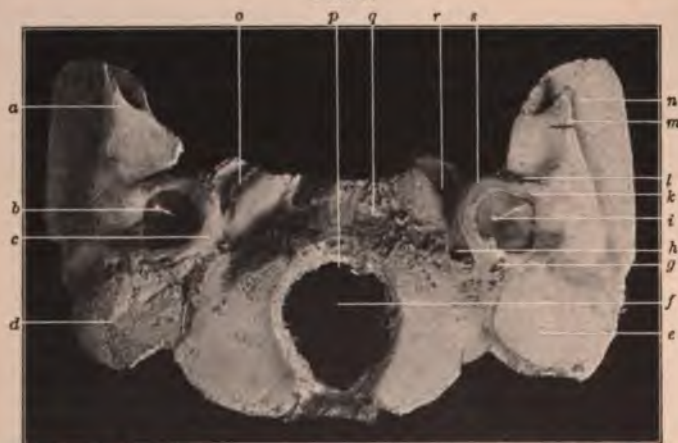


Left tympanic ring of an infant turned forward upon its anterior limb and viewed from within. (Gruber.) *h*, anterior extremity of the ring, and just below it the spina tympani major; *sm*, spina tympani anterior; and between *sm* and *h* is the crista spinarum; *ct*, the crista tympanica, ending below and in front in the spina tympani inferior, *st*, and above and behind in the spina tympani major; between the crests lies the sulcus malleolaris; *v*, posterior extremity of the ring, forming anteriorly the spina tympani posterior.

posterior part (Fig. 8A, *p*) the posterior tympanic tubercle. From these two tubercles begins the ossification that forms the tympanic bone, the antero-inferior wall of the osseous auditory canal. Below the anterior tympanic tubercle is the so-called *spina tympani inferior* (Fig. 8B, *st*).

On the inner surface of the anterior arm of the tympanic ring (Fig. 8B, *h*) is a small spine, called the *spina tympani major*. This spine is concave on its posterior border and forms the anterior end of the *incisura Rivini*, lodging the head of the malleus. In front of and a little below the *spina tympani major* is another spine pointing outward and forward, called the *spina tympani anterior*. Connecting these two spines is the *crista spinarum* (Fig. 8B). Below the centre of the anterior border of the inner surface of the front arm of the tympanic ring there is a spine directed forward and inward, called the *spina tympani inferior* (Fig. 8B, *st*). Between the *spina major* and the *spina inferior* is the *crista tympanica* (Fig. 8B, *ct*). Between the *crista spinarum* and the *crista tympanica* is a groove, called the *sulcus malleolaris* (Fig. 8B, *ct-st*), which lodges part of the anterior ligament of the malleus, the *processus gracilis* of the malleus, the tympanic branch of the internal maxillary artery, gives passage to the chorda tympani nerve on its way to the tongue, and forms the anterior boundary of the Glaserian fissure.

FIG. 9.



Base of infant's skull, from photograph. *a*, right zygoma; *b*, right membrana; *c*, annulus tympanicus; *d*, right mastoid portion; *f*, foramen magnum; *e*, left mastoid portion; *g*, stylomastoid foramen; *h*, jugular foramen; *i*, umbo of the left membrana tympani; *k*, annulus tympanicus, in front and above; *l*, Glaserian fissure; *m*, zygoma; *n*, squama; *s*, annulus tympanicus, in front and below; *r*, left carotid canal; *p*, *q*, basilar process of occipital bone; *o*, right carotid canal.

The anterior border of the tip of this surface is slightly prominent, and is called the *spina tympani posterior* (Fig. 8B, *v*). It forms the posterior angle of the Rivinian incisure, and gives attachment to the posterior ligament of the malleus.

At birth the plane of the annulus tympanicus and membrana tympani

conforms closely to the plane of the skull base (Fig. 9, *i, k, s*), whereas in adult life it conforms more to the plane of the side of the skull.

The gradual outward growth of the tympanic ring forms the antero-superior, the anterior, and the antero-inferior walls of the bony auditory canal. To this development of the annulus tympanicus is also given the name of tympanic bone.

The External Auditory Canal at Birth.—At birth the lower wall of the external auditory canal is almost in contact with the membrana tympani and the upper wall of the canal. This is due to the fact that at this time bone does not enter into the formation of the auditory canal, and hence its upper and lower fibro-cutaneous walls easily come together. The plane of the membrana corresponding at this time to that of the upper wall of the canal, the membrana is covered by the lower wall of the canal by this collapse. Therefore, in examining the ear of an infant, the auricle and the lower wall of the canal must be drawn downward in order to gain a view of the membrana tympani (Fig. 10).

FIG. 10.



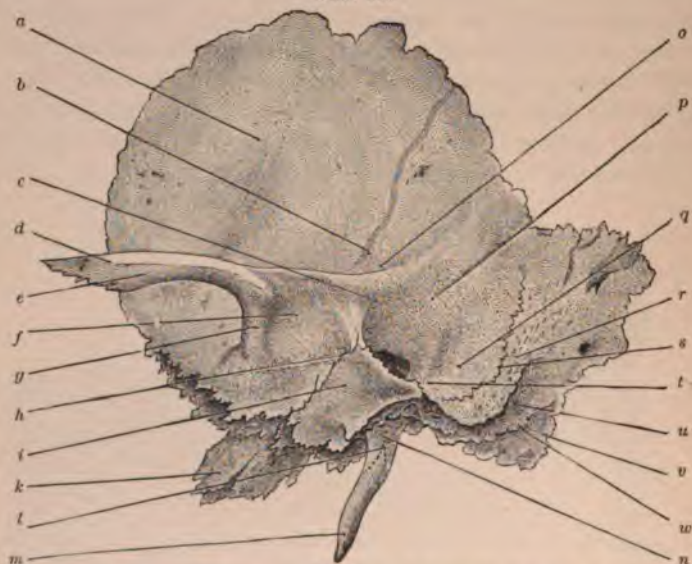
Vertical section through the right external auditory canal of a human embryo of seven months, natural size. (G. Schwalbe.) *a*, section through the annulus tympanicus; *ab*, lamina tympanica fibrosa; *bc*, floor of the cartilaginous auditory canal; *ad*, membrana tympani with the malleus in the drum-cavity; *d, e*, part of roof of the canal near its meatus, formed by the temporal bone; *f*, cartilaginous auricle; *g*, parotid gland.

The neck of the malleus fits in between the two spines of the annulus tympanicus (Fig. 8*B, v, h*) in such a manner that the anterior, the spina tympani major, almost touches it. This relation of the parts is not seen, however, from without. The deficiency in the annulus tympanicus between these two points is supplied by the tympanic process of the squama, the so-called "scute" (Fig. 5, *k*). The gradual outward growth of the annulus tympanicus, in front, below, and to some extent behind, together with the outward growth of the tympanic and mastoid surfaces of the squama above and behind, form at last the osseous external auditory canal (Fig. 11, *i, c*). The anterior wall of the auditory canal, developed entirely from the annulus tympanicus, is called the *tympanic bone* (Fig. 11, *i*). Together with the lower glenoid surface (Fig. 11, *f*) it forms the posterior wall of the joint of the inferior maxilla. Between the tympanic and the

glenoid surface lies the Glaserian fissure (Fig. 11, *h*). It is thus shown that the front wall of the external auditory canal is the back wall of the maxillary joint, which explains the fact that in inflammation of the external auditory canal motion of the jaw is painful.

A view of the *outer surface* of the temporal bone of the adult shows that the parietal surface of the squama (Fig. 11, *a*) forms a sharper angle with the tympanic or horizontal portion (Fig. 11, *c*) than in the infant's bone. This is due to the outward or horizontal growth of the tympanic

FIG. 11.



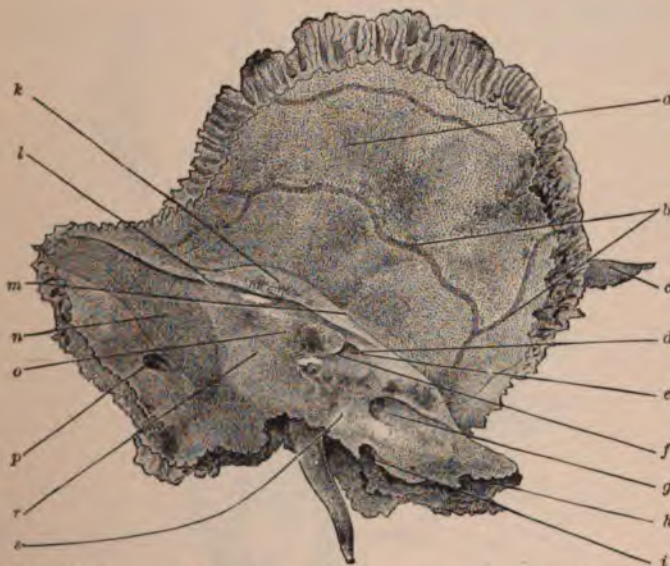
Fully developed left temporal bone, outer surface. *a*, squama; *b*, groove for temporal artery; *c*, external auditory meatus; *d*, zygomatic process; *e*, insertion of masseter muscle; *f*, glenoid fossa; *g*, articular ridge; *h*, Glaserian fissure; *i*, tympanic bone: anterior wall of external auditory canal; *k*, inner end of petrous or pyramidal portion of temporal bone; *l*, insertion of styloglossus muscle; *m*, styloid process; *n*, insertion of stylohyoid muscle; *o*, insertion of temporal muscle; *p*, *q*, mastoid portion; *t*, mastoid process; *r*, insertion of sterno-cleido-mastoid muscle; *s*, squamomastoid fissure; *u*, mastoid incisure; *w*, insertion of splenius capitis muscle; *v*, insertion of trachelomastoid muscle.

and mastoid portions of the squama with that of the annulus tympanicus, in the formation of the osseous auditory canal (Fig. 11, *c*, *p*, *q*, *i*). The groove for the temporal artery is seen running across the squama (Fig. 11, *b*), the external auditory meatus is now complete and ready for the attachment of the auricle, the zygoma is a strong process (Fig. 11, *d*) for the insertion of the masseter muscle (Fig. 11, *e*), and the glenoid fossa and the tympanic bone (Fig. 11, *f*, *i*) complete the posterior maxillary articular surface.

The *inner surface* of the temporal bone of the adult is also important for otological study. It will be seen that the petrous pyramid of the bone divides the middle from the posterior cranial fossa, the posterior

pyramidal surface being the anterior wall of the posterior fossa, and the anterior surface of the petrous pyramid, containing the tegmen tympani, forming the posterior wall of the middle cranial fossa. Over the tegmen tympani and against the squama lies the temporal lobe of the brain. The meningeal artery courses over the inner surface of the squama (Fig. 12, *b*). On the posterior part of the petrous pyramid, at its upper boundary, may be seen the eminence made by the superior semicircular canal (Fig. 12, *k*). Just below this runs the groove for the superior petrosal sinus

FIG. 12.



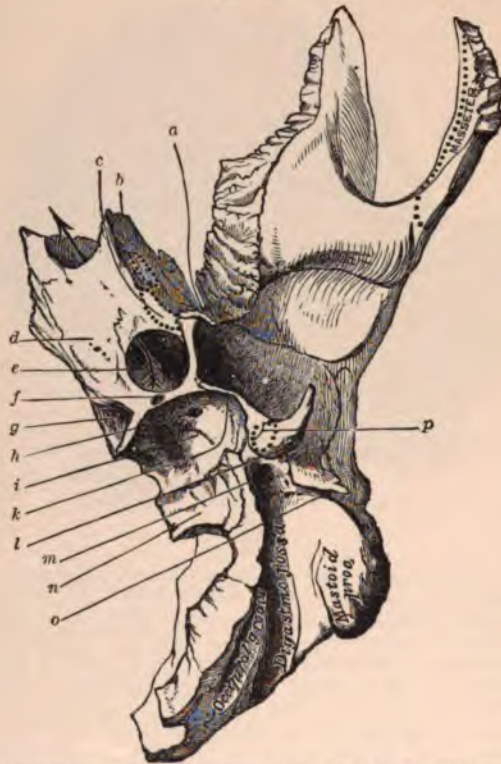
Fully developed left temporal bone, inner surface. *a*, squama; *b*, meningeal groove; *c*, zygomatic process; *d*, semi-canal of Vidian nerve; *e*, hiatus of Fallopian canal; *f*, canaliculus petrosus empties into this groove; *g*, porus acusticus for auditory nerve; *h*, carotid canal; *i*, jugular notch; *r*, *o*, petrous or pyramidal part of bone; *p*, mastoid foramen for vein; *n*, sigmoid groove for lateral sinus; *l*, groove for superior petrosal sinus; *k*, eminence of superior semicircular canal; *m*, petrosquamous suture; *s*, aquæductus vestibuli.

(Fig. 12, *l*). This enters the lateral sinus (Fig. 12, *n*). The mastoid vein enters the same blood-channel at the mastoid foramen (Fig. 12, *p*). The jugular foramen is completed at the jugular notch (Fig. 12, *i*), and the carotid canal has its exit at the point of the petrous bone (Fig. 12, *h*). The auditory nerve, with the facial nerve, enters the petrous bone at the porus acusticus internus (Fig. 12, *g*). Behind and below the porus acusticus is the entrance of the aquæductus vestibuli (Fig. 12, *s*), the conveyer of endolymph to the membranous labyrinth. The perilymph escapes from the labyrinth by the way of the aquæductus cochleæ. Above and beyond the porus acusticus lie the semi-canal for the Vidian nerve and the hiatus of the Fallopian canal (Fig. 12, *d*, *e*). Into this groove the canaliculus petrosus empties (Fig. 12, *f*).

It should also be borne in mind that on the upper cerebral surface of the petrous portion of the temporal bone are the petrosal sinuses, closely connected with the cavernous sinus, and that into the latter, in turn, empties the ophthalmic vein, a relationship that explains the obstruction in the circulation of the veins of the face and eye occurring in otitic phlebitis and thrombosis in the cerebral sinuses.

The Under Surface of the Temporal Bone.—Under the floor of the drum-cavity lies the jugular bulb (Fig. 13); the anterior wall of the drum-

FIG. 13.



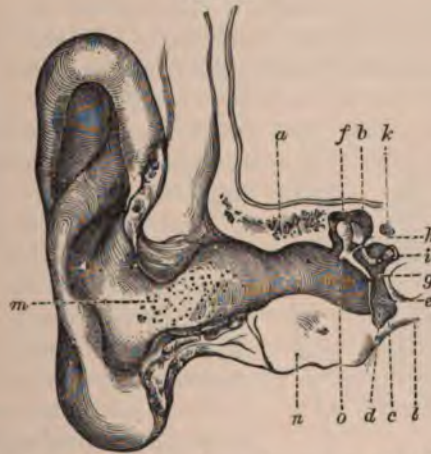
Under surface of the left temporal bone. (Gray.) *a*, canals for Eustachian tube and tensor tympani muscle; *b*, tensor tympani; *c*, levator palati; *d*, rough quadrilateral surface; *e*, opening of carotid canal; *f*, canal for Jacobson's nerve; *g*, aqueductus cochleæ; *h*, canal for Arnold's nerve; *i*, jugular fossa; *k*, vaginal process; *l*, styloid process; *m*, stylomastoid foramen; *n*, jugular surface; *o*, auricular fissure; *p*, stylopharyngeus.

cavity is part of the carotid canal (Fig. 13); the roof of the drum-cavity is a thin septum of bone forming part of the floor of the middle cranial fossa; and the mastoid cells are separated by a thin partition of bone from the sigmoid groove, or fossa, in which runs the lateral sinus of the dura mater, and beyond which lies the posterior cranial fossa. Inspection of the base of the temporal bone (Fig. 13) shows that the medial

wall of the mastoid process forms part of the digastric groove or fossa; the canal for Arnold's nerve lies in the jugular fossa; the canal for Jacobson's nerve lies between the jugular and the carotid; and the bony portion for the Eustachian tube and the semi-canal for the tensor tympani muscle have their inner wall in common with the outer wall of the carotid canal, on the inner end of the petrous portion or pyramid of the temporal bone. It must also be borne in mind that the entire internal ear or labyrinth lies in the petrous part of this important bone (Fig. 12, *k*).

The Auditory Canal.—The completely developed external auditory canal extends from the bottom of the concha to the drum-head, and con-

FIG. 14.



Vertical section of the external auditory canal, membrana tympani, and tympanic cavity, viewed from in front. (Politzer.) *a*, upper osseous wall of the canal; *n*, lower osseous wall of the same; *b*, tegmen tympani; *c*, osseous floor of the tympanic cavity; *d*, tympanic cavity; *e*, membrana tympani; *f*, head of the malleus; *g*, lower end of the handle of the malleus; *o*, short process of the malleus; *h*, body of the incus; *i*, stapes in the oval window; *k*, Fallopian canal; *l*, jugular fossa; *m*, glandular orifices in the skin of the cartilaginous canal.

sists of a cartilaginous and bony portion, the former being about one-third, and the latter about two-thirds, of the passage-way. The length of this canal is about one inch and a quarter, and its average width about a quarter of an inch. The canal gradually narrows to the middle of the bony portion (Fig. 14, *a-n*), where it widens again gradually to the membrana tympani. The external auditory canal is lined with skin, a continuation inward of that of the auricle, and *not with mucous membrane*. The skin of the auditory canal is extended over the outer surface of the membrana tympani, forming the extremely thin and delicate dermoid, or outer layer (Fig. 14). In the bony portion of the auditory canal the skin is thin and closely adherent to the bony walls. It forms a very sensitive, silvery-white cutaneo-periosteum, and by reason of its sensitiveness acts

as a protection to the drum-membrane by warding off manipulation of the canal walls near the membrana. In the anterior wall of the cartilaginous auditory canal there are deficiencies called the *incisurae Santorini* (Fig. 15, c, c), and there is also a cleft in the upper wall of the cartilaginous part of the auditory canal. The general course of the adult's external auditory canal may be said to be sigmoid or spiral, turning inward and downward. Hence, to inspect the membrana tympani through the auditory canal, the auricle must be drawn slightly upward and backward to straighten the canal and permit the entrance and reflection of light. In some individuals the auditory canal is so straight that the membrana tympani can be seen at the bottom of the canal without traction on the auricle or dilatation of the meatus by an ear-funnel. In the negro race the auditory canal is usually very wide and straight.

Upon the entire free surface of the cutis of the auditory canal are found epidermis and delicate, short hairs, together with the sebaceous glands usually found therewith. Throughout the canal, but especially in the cartilaginous portion, are found numerous modified sudoriferous glands, constituting the ceruminous glands of the meatus.

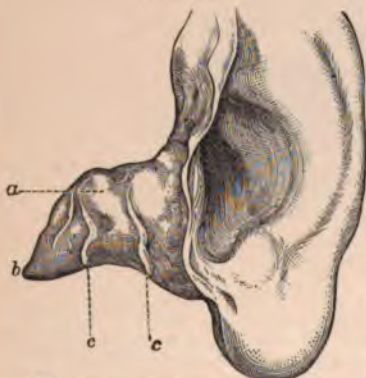
Ceruminous Glands.—These glands begin about two millimetres from the opening of the auditory canal and extend to within two or three millimetres of the drum-head. They are most numerous at the junction of the cartilaginous with the bony canal, where they average as many as ten to the square millimetre. According to Buchanan, there are from one to two thousand wax glands in each auditory canal. The skin in the cartilaginous part of the auditory canal is one and one-half millimetres thick.

Vessels and Nerves.—The arteries supplying the auditory canal are

branches from the posterior auricular, internal maxillary, and temporal branches of the external carotid artery. The nerves are chiefly derived from the temporo-auricular branch of the inferior maxillary nerve. There is also an *auricular branch* of the pneumogastric nerve. The plexus of the sympathetic nerve, distributed to the external carotid artery, communicates with the otic and submaxillary ganglia by means of the plexus distributed to the facial and internal maxillary arteries.

Relation of the Fallopian Canal to the External Auditory Canal.—According to Gellé (*Annales des Maladies de l'Oreille*, etc., January, 1894), the

FIG. 15.



The auricle and the cartilaginous part of the external auditory canal, left side. (Politzer.) a, cartilaginous meatus; b, inner pointed end which unites with the osseous part of the auditory canal; c, c, fissures of Santorini.

Fallopian canal, on its way from the drum-cavity to the stylomastoid foramen, crosses the posterior edge of the ring of the membrana tympani at a point where a line drawn horizontally through the umbo of the membrana reaches the posterior wall of the osseous auditory canal. At this point the Fallopian canal is only from two to three millimetres from the surface of the posterior wall of the auditory canal. The extra-tympanic portion of the Fallopian canal continues to be superficial in the posterior wall of the auditory canal for a distance of five millimetres, being in this tract from three to four millimetres from the surface. Then the canal passes deeper inward and downward into the bone to reach the stylomastoid foramen.

Escape of Cerumen from the Ear.—The ear-wax is formed in the wide end of a truncated cone,—*i.e.*, near the outer end of the auditory canal. Therefore, as the ear-wax forms and collects it presses upon the walls of the auditory canal, which being widest and freest towards its mouth on the outer side of the gradually growing mass of cerumen, the latter meets with the least obstruction just in the direction of its only way of escape. Hence the wax ball will be acted upon very much as if it remained a constant quantity continually pressed upon from behind and pushed outward by a gradually narrowing auditory canal.

Another force aiding in the outward movement of a ball of ear-wax, if let alone, is the fact that there is a natural outward growth of the skin of the auditory canal from the membrana tympani towards the external meatus. This can be seen by watching a small scratch on the dermoid surface of the membrana. Such a mark will be observed to move gradually away from the malleus, across the membrana, and finally out onto the wall of the auditory canal, just as a spot on the finger-nail moves from the matrix towards the finger-end.

CHAPTER III.

THE ANATOMY AND PHYSIOLOGY OF THE MEMBRANA TYMPANI.

Dermoid Layer.—The membrana tympani, or drum-head, is situated at the fundus of the external auditory canal, and is composed of three layers,—viz., the external or dermoid layer; the middle or fibrous layer, also called the membrana propria; and the internal or mucous layer. The dermoid layer of the membrana tympani is a continuation of the delicate cutis of the external auditory canal. On this layer there are, however, no hairs or follicles such as are found elsewhere in the cutis of the auditory canal. In other respects it is true skin, but very thin and transparent.

The Outer Surface of the Membrana Tympani.—The dermoid layer is the only one of the three layers of the drum-head which can be inspected directly from without. When the auditory canal is illuminated and a normal membrana tympani looked at from without, there are several prominent features in it attracting immediate attention,—viz., its almost circular shape and peculiar polish and color; its vertical and horizontal inclinations; the handle or manubrium of the malleus; the short process of the malleus; the folds of the membrana tympani; the flaccid portion of the drum-head above these folds, the so-called membrana flaccida, or Shrapnell's membrane; and the bright triangular reflection of light in the antero-inferior quadrant of the membrana, called the "triangle or pyramid of light." In most normal membranæ there may be seen also in the superior-posterior quadrant the long process of the incus showing through from the drum-cavity. The examiner of the normal membrana will also perceive that its general surface is concavo-convex, or of a broad and shallow funnel shape, with its centre at the umbo at the lower end of the malleus handle.

Segment of Rivinus.—The line of attachment of the membrana tympani shows a slight, ill-defined depression where it passes above the short process of the malleus. This segment of the upper periphery of the tympanic ring is called the segment of Rivinus, since it includes the foramen described by him as representing in some cases the trace of the first visceral cleft, but which has no existence in the vast majority of full-grown ears.

Shape of the Membrana Tympani.—For purposes of clinical convenience in description, the periphery of the membrana tympani is called circular. Strictly it is an ellipse, the long diameter of which, amounting to from nine to ten millimetres, runs from above and in front, downward and backward, and the diameter of greatest width of which runs from below and in

front, upward and backward. The proportion between these diameters is as 4.3 is to 4. (Hyrtl and von Troeltsch.) The longer diameter is called the vertical diameter, the diameter of greatest width is called the horizontal diameter, and the membrana is spoken of as circular. The latter is, therefore, divided into quadrants which greatly aid in locating points to be described.

Color of the Membrana Tympani. The color of a normal membrana varies in individuals just as the color of normal teeth varies from bluish

FIG. 16.



Base and squama of the left petrous bone showing the inclination of the membrana tympani in the adult, natural size, from photograph. *a, b*, section through the zygoma; *c*, upper anterior glenoid surface; *d*, short process of malleus; membrana flaccida above it; *e*, cut edge of anterior wall of the osseous auditory canal partly removed to show the membrana in position; *f*, membrana tympani; *g*, Glaserian fissure; *h*, anterior wall of the osseous auditory canal; *i*, foramen ovale; *k*, foramen rotundum; *x*, foramen lacerum; *l*, articular condyle, and *m*, basilar process, of the occipital bone; *n*, anterior condyloid foramen; *o*, jugular foramen; *p*, carotid foramen, oblique view; *q*, occipital surface; *r*, umbo of the membrana; *s*, digastric groove; *t*, outer mastoid surface; *u*, upper posterior wall of auditory canal; *v*, squama; *w*, parietal surface.

to yellowish white. Just so a normal membrana tympani may be bluish or yellowish gray. It is generally spoken of as "pearl-gray," but whatever its color may be, it is always modified by the physical conditions brought about by its being a nearly transparent membrane stretched over a darkened cavity. Its color must always be modified by the color and condition of the contents of the drum-cavity. That part of the membrana behind the lower end of the malleus handle is rendered

yellowish gray by the light reflected from the promontory of the cochlea on the inner tympanic wall.

Lustre of the Membrana Tympani.—The membrana tympani owes its peculiar lustre to the delicate and shining epithelium of the dermoid layer. The slightest maceration or exfoliation of this epithelium deprives the membrana of its beautiful lustre. The dermis of the drum-membrane is thickest in young children.

Inclinations of the Membrana Tympani.—The normal membrana tympani in the adult is inclined outward at an angle of forty-five degrees in its vertical plane. In a horizontal plane the membrana is inclined at its posterior periphery on the right side ten degrees farther to the right than the anterior boundary, and on the left side, in the same sense, ten degrees farther to the left. If the planes of both membranæ be extended downward until they intersect each other, the angle thus formed will equal from one hundred and thirty to one hundred and thirty-five degrees. If a perpendicular be drawn from the upper pole of the membrana to the inferior wall of the auditory canal, it will strike the latter about six millimetres from the inferior pole of the drum-head. A similar result will be obtained by drawing a perpendicular from the middle of the posterior periphery of the membrana to the anterior wall of the auditory canal. From this it is seen that the posterior segment of the membrana tympani is nearer the mouth of the external auditory canal than is the anterior segment. The plane of the adult membrana tympani corresponds more nearly to the plane of the side of the skull (Fig. 16, *f*), while the plane of the membrana in the infant and young child corresponds very nearly to that of the base of the skull (Fig. 9, *s* and *i*; *b* and *c*).

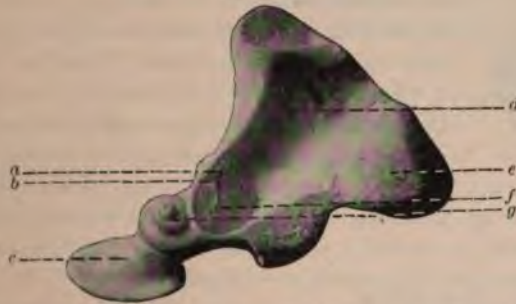
Sometimes the segment of Rivinus is filled in with osseous tissue, and in consequence the superior wall of the auditory canal dips downward to join the membrana tympani on a line with its folds. In such cases there is very little or no membrana flaccida. Such conditions I have observed most frequently in the feeble-minded or in any one with defective cranial development.

Manubrium of the Malleus.—Running from the superior pole of the membrana, downward and slightly backward to the centre of the drum-head, is seen the ridge formed by the manubrium, or handle of the malleus (Fig. 17, *b-f*). This slightly elevated ridge, entirely opaque and decidedly whiter than the surrounding drum-head, divides the membrana tympani into its two segments, the anterior and the posterior. At the upper end of this ridge, in the line of the folds of the membrana and beneath the membrana flaccida (Fig. 17, *a*), is the *short process* of the malleus, projecting sharply outward somewhat above the general surface of the handle of the hammer (Fig. 17, *b*). Its general appearance is not unlike a pimple with pale-yellow contents.

The lower end or tip of the ridge, which curves slightly forward, is flatter, broader, and yellower than the rest of the outer covering of the

manubrium. This is due to the fact that the bone proper is spade-shaped at this point, and also because the radial fibres of the membrana propria centre at this lower part of the bone. The lower end of the manubrium draws the membrana tympani inward very markedly, and forms the pale-yellow depressed spot in the centre called the *umbo*.

FIG. 17.



Left membrana tympani in position; anterior wall of the osseous auditory canal cut away; adult bone, from photograph. *a*, membrana flaccida, or Shrapnell's membrane; *b*, short process of malleus; *c*, anterior wall of internal auditory canal, for auditory nerve; *g*, cochlea; *f*, membrana tympani; *e*, mastoid process; *d*, upper back wall of osseous external auditory canal.

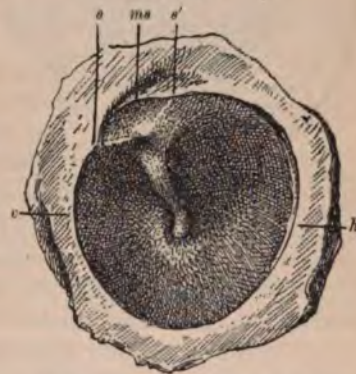
The convex shape of the drum-head from the tip of the manubrium outward towards the periphery is due to the comparatively large number of circular fibres at a point between the umbo and periphery, which constrict, as it were, the radial fibres, so as to form a kind of funnel.

Pressure or traction applied to the centre of a membrane stretched over a ring tends to draw the former into a cone. But if a smaller concentric ring be placed so as to resist the indrawing force at the centre, the whole membrane is drawn into a concavo-convex shape.

Folds of the Membrana Tympani.—From the short process of the malleus two delicate ridges may be seen, one running forward, the other backward, to the periphery of the membrane. They are the so-called folds of the membrana tympani (Fig. 18, *s*, *s'*). The sharply defined crests of these ridges have been called by some

Prussak's bands. Above these folds and bands is the so-called *membrane of Shrapnell*, or *membrana flaccida*. This flaccid membrane consists only of dermoid and mucous layers, the fibrous layer being wanting at this point. The feeble resistance of this part of the membrana renders it easy of per-

FIG. 18.



Outer surface of the membrana tympani; enlarged four diameters. (Poltzer.) *v*, *h*, annulus tympanicus; *s*, *s'*, folds of the membrana tympani; *ma*, membrana flaccida, or Shrapnell's membrane.

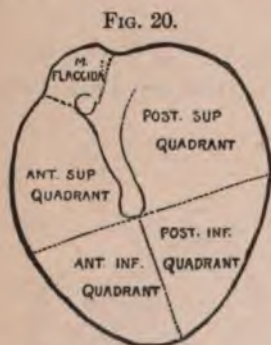
foration, which may have given rise to the now exploded idea that there was a normal opening at this point, the so-called foramen of Rivinus.

Pyramid of Light.—The pyramid of light is a name applied to the beautiful triangular reflection of light emanating from the antero-inferior quadrant of the normal membrana tympani. The apex of this triangular reflection touches the tip of the manubrium of the malleus, and its base



lies on the periphery of the membrana tympani. It forms, with the handle of the malleus, an obtuse angle anteriorly, which becomes greater as the inclination of the membrana tympani to the auditory canal diminishes. Its average height is from one and one-half to two millimetres, and its average width at the base is from one and one-half to two millimetres. This reflection, which has been called an isosceles triangle from its general appearance, is, strictly considered, pyramidal in shape, and hence the name applied to it by most writers of the present day (Fig. 19).

Geometric Divisions of the Membrana Tympani.—For clinical convenience the membrana tympani may be divided into quadrants and the region of the membrana flaccida (Fig. 20).



Quadrants of the membrana tympani and the membrana flaccida. (Siebenmann.)

Annulus Tendinosus.—The so-called annulus tendinosus,¹ or tendinous ring of Arnold, is a mass of fibrous tissue arranged around the periphery of the membrana tympani, effecting the union between the latter and the inner edge of the external auditory canal.

The *annulus tendinosus* is not found, however, at that part of the periphery of the membrana tympani corresponding to the Rivinian segment, nor is it always visible from without, even when present in its normal position, around the periphery close to the annulus tympanicus.

The fibres of the membrana propria, described farther on, are not inserted directly into the bone of the manubrium, but into a cartilaginous groove which receives the manubrium and short process.

Inner Surface of the Cartilaginous Groove.—The inner surface of this cartilaginous groove, which is in contact with the malleus, is lined by a very delicate layer of connective tissue, between which and the malleus there is found a small amount of fluid resembling synovia. As this condition of discontinuity between the malleus and the inner surface of the cartilaginous groove is considered normal, it is fair to presume that, such being the case, the malleus can make a certain amount of motion in this groove, and that therefore there is here a kind of joint.

¹ The annulus cartilagineus of the older writers.

I have seen cases that appeared to have *two* short processes projecting from the upper end of the manubrium. Such an appearance is explained by Gruber as the result of a dislocation or slipping upward of the entire malleus out of this cartilaginous groove; the upper of the "two short processes" in such a case is the true bony short process, whereas the lower one is the aforesaid cartilaginous cap, moulded over the short process, and held in the original position of the true short process by the membrana tympani. This condition is due to a subluxation of the cartilage from the short process.

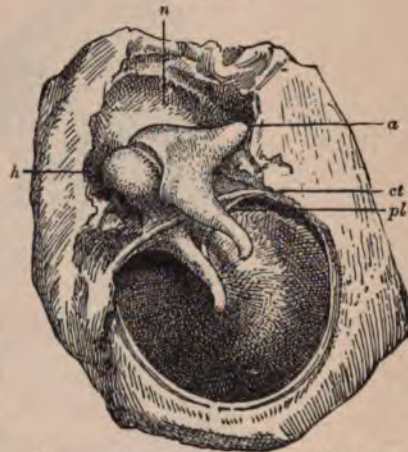
The Membrana Propria, the Fibrous or Middle Layer of the Membrana Tympani.—The *membrana propria* can be subdivided into two distinct and delicate layers,—viz., an *outer*, composed entirely of radiate fibres intimately connected with the dermoid layer of the drum-head; and an *inner*, composed entirely of circular fibres in close relation with the mucous membrane composing the internal layer of the membrana tympani. These component layers of the membrana propria are named, briefly, the radial and the circular layer. The fibres composing the former arise from the annulus tendinosus and the upper wall of the auditory canal, and are inserted into the manubrium of the malleus, centring for the most part at its spade-like tip. The fibres composing the circular layer arise partly from the annulus tendinosus, but the majority of them arise from the substance of the membrana tympani itself (von Troeltsch). Some of them are inserted into the malleus.

Constituent Elements of the Membrana Propria.—Toynbee, von Troeltsch, Gerlach, and Gruber have added to the knowledge of the nature and dimensions of the constituent elements of the *membrana propria*.

It consists chiefly of connective tissue of that variety half-way between the ordinary fibrillated and the homogeneous connective tissue of Reichert, as shown by Gerlach.

The fibres are 0.004" broad and 0.002" thick, and on account of their ribbon-like shape they were once supposed to be unstriated muscle fibres, which they are not. On these fibres certain peculiar spindle-shaped cor-

FIG. 21.

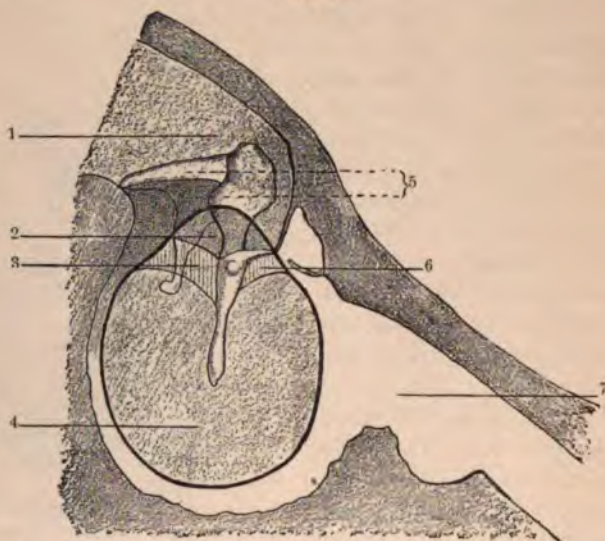


Inner surface of the right membrana tympani, with the malleus and incus attached to each other, enlarged three and one-half times. (Politzer.) *n*, niche in the outer wall of the tympanic cavity, in the squama; *h*, head of the malleus; *a*, short process of the incus; *pl*, fold of the posterior pouch of the membrana tympani; *ct*, chorda tympani nerve. The fold of the anterior pouch of the membrana lies in front of the neck of the malleus, concealing the upper anterior attachment of the membrane and carrying the chorda tympani nerve to the anterior osseous wall and to the Glaserian fissure.

puscles are found. The latter were supposed to be peculiar to the membrana tympani, and have been called "corpuscles of the membrana tympani," or the "corpuscles of von Troeltsch," after the observer who first drew attention to their existence. They are, however, connective-tissue corpuscles of Virchow. They are about 0.002" long and 0.005" wide at their broadest part, with from two to three processes. According to Gruber, these bodies are found in two varieties in the membrana tympani,—viz., the spindle-shaped and the stellate variety.

The Internal or Mucous Layer of the Membrana Tympani.—The internal layer of the membrana tympani is composed of mucous membrane, a

FIG. 22.



Pouches of the membrana tympani in their relation to the membrana flaccida. (Siebenmann.)
1, attic and aditus; 2, upper pouch of the membrana; 3, posterior pouch; 4, membrana tympani;
5, malleo-incudal space; 6, anterior pouch of the membrana; 7, Eustachian tube.

reflection of that lining the tympanic cavity. It is thickest at that point where it leaves the cavity of the middle ear and passes over the periphery of the drum-head. It grows gradually thinner as it approaches the centre of the membrana tympani, where it is extremely delicate.

On the inner surface of this layer various observers, among whom may be named Politzer, Gerlach, and Kessel, have found villi or papillæ.

Fold of Mucous Membrane for the Chorda Tympani.—The mucous membrane of the tympanic cavity covers the entire inner surface of the membrana tympani. Near the upper boundary of the latter it is reflected over the chorda tympani and back again to the drum-head.

By this means a duplicature or fold of mucous membrane is formed, the opening of which is turned towards the surface of the membrana

tympani, and in the cul-de-sac or inner edge of which the chorda tympani is found.

Pouches of the Membrana Tympani.—The aforesaid fold is adherent to the inner surface of the neck of the hammer, and being thus divided into an anterior and posterior portion, contributes to make the inner boundaries or sides of the two pouches of the membrana tympani described by von Troeltsch. Further explanation of the pouches will be given under the consideration of the contents of the tympanic cavity.

Vascular Supply of the Membrana Tympani.—The membrana tympani obtains its blood-supply from the tympanic branch of the inferior maxillary artery, and also by means of a short, direct branch from the *internal carotid* in the carotid canal. By the latter channel, the membrana may become quickly engorged.

CHAPTER IV.

THE ANATOMY AND PHYSIOLOGY OF THE TYMPANIC CAVITY.

EMBRYOLOGY OF THE TYMPANIC CAVITY.

THE first trace of the middle-ear cavities is formed by the first inner branchial furrow or pharyngeal pouch, a dilatation of the lateral pharyngeal tract. In the first month of embryonal life this broad, pit-like pouch, still open towards the pharynx, as far as can be decided from its relation to the internal carotid, corresponds to the middle third of the drum-cavity. By the middle of the sixth week of embryonal life it forms a narrow cleft running in the frontal plane. The floor of the pouch, running steeply towards the pharynx, now reaches as far as the carotid, so that the anterior or tubal portion of the drum-cavity is formed and may be regarded as in some degree fully marked off. The point of the pouch corresponding to the posterior end of the foetal tympanic cavity lies between the handle of the hammer and the long process of the anvil. This is not directed exactly outward, but is curved somewhat backward. The two foetal drum-cavities at this time appear like wing-shaped, lateral appendages of the pharynx. (Siebenmann.)

At this time no parietal piece exists corresponding to the Eustachian tube. However, the increase in length of the tubo-tympanal space keeps equal pace with the rapid increase in thickness in front of the layer of soft tissue surrounding the pharynx. In this way, as the auditory canal is inserted between the concha and membrana tympani, the Eustachian tube inserts itself after the sixth week between the pharynx and middle ear. (Siebenmann.)

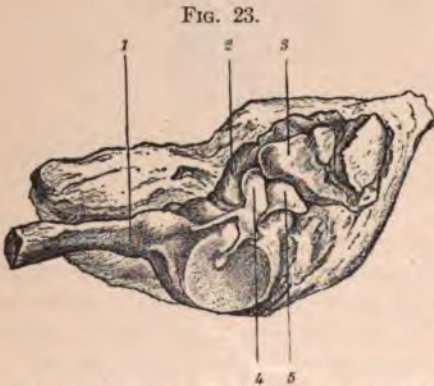


FIG. 23.
Cast of the middle ear of new-born child, right side. (Siebenmann.) 1, Eustachian tube; 2, attic; 3, antrum; 4, malleus; 5, incus.

The tympanum and the Eustachian tube, derivatives of the entoderm, are to be regarded as differentiations of the primitive pharyngeal cavity. The dorsal part of the closing membrane of this cleft persists as the tympanic membrane. The outer layer of the membrana originates from the ectoderm, the inner layer from the entoderm, and the middle fibrous layer from the mesoderm.

Auditory Ossicles.—The foundation of the stapes in the human embryo appears at the end of the fourth week as an irregular layer of blastema rich in cells. This lies in the dorsal wall of the first pharyngeal pouch, and externally is in continuous connection with the blastema corresponding at that point to the richly cellular, blending tract of the first and second branchial arches.

The malleus and incus are not, even in the fifth week, indicated by any special grouping of cells. At the beginning of the sixth week, however, the anterior cartilaginous structures of the first and second branchial arches differentiate, and simultaneously with the appearance of Meckel's and Reichert's cartilaginous rods appear also indications of the malleus and the incus. Ossification of a piece of the proximal end of Meckel's cartilage, the so-called *articulare*, produces the *malleus*. Ossification of the piece of cartilage remaining from the *palato-quadratum*, representing the proximal end of the original bar of cartilage in the mandibular arch, forms the *incus*.

ANATOMY.

Under the term Middle Ear are included the tympanic cavity and its two very important adjuncts,—the Eustachian tube in front, and the mastoid portion of the temporal bone, and its cells, behind (Fig. 24).



FIG. 24.
Cast of middle ear of a child of nine months, outer surface. (Siebenmann.) 1, Eustachian tube; 2, large pneumatic cell of the inner and upper wall of the osseous part of the Eustachian tube; 3, attic; 4, antrum, encroached upon by mastoid cells.

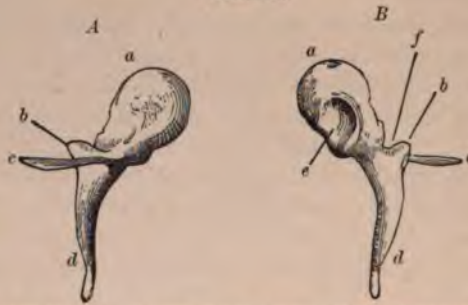
Ossicles of Hearing.—In the tympanic cavity of all mammals are three small bones,—the *malleus*, or hammer; the *incus*, or anvil; and the *stapes*, or stirrup.

Anatomists of a later day have shown that the once so-called *os orbiculare*, or *os Sylvii*, does not exist as a separate ossicle. That which once received this name is the *processus lenticularis* of the long limb of the incus, which fits into a corresponding depression in the head of the stapes.

The Malleus.—The malleus, or mallet, is divided into head, neck, and handle (Fig. 25). At the junction of the handle with the neck are two important processes,—viz., the *short process* on the outer surface, which, when in its normal situation, pushes the *membrana tympani* ahead of it,

and points towards the auditory canal, and the *process of Rau* or *Folius*, which passes anteriorly into the Glaserian fissure. In the fœtus and new-born child this process is about three and one-half lines long, and can then be removed whole in connection with the malleus. After birth

FIG. 25.



Right malleus: *A*, from in front; *B*, from behind; magnified four diameters. (Henle.) *a*, head; *b*, short process; *c*, long process; *d*, manubrium; *e*, articular surface; *f*, neck.

it unites with the under wall of the Glaserian fissure, and when the malleus is removed, only a short piece of the former long process is found attached to it. This remnant was all that was known of the long bony process to the older anatomists, and it has been called the *processus Folianus*, after *Folius*,¹ who, in describing this process, alluded only to the remnant.

The *head* and *neck* of the malleus project into the tympanic cavity, and are entirely free from the *membrana tympani* (Fig. 23, 4). The rounded, smooth surface of the head is directed anteriorly, while the surface which articulates with the incus is directed backward. The long diameter of its articular surface runs vertically; the short diameter, horizontally.

In the direction of the former, the articulating surface has been said to resemble a saddle, for the surface is divided a little below the middle by a horizontal ridge, and depressed on each side of it. This articulating surface is also concave in the direction of its short diameter,—*i.e.*, from without inward.

The *neck* of the malleus lies between the head and the manubrium. It makes, with the former, an angle of about one hundred and thirty-five degrees when viewed from in front. It has three surfaces,—a *broad inner* one directed towards the tympanic cavity, bounded in front by the *processus Ravii*, or long process, and behind by the long, low, bony elevation for the insertion of the tendon of the *tensor tympani*; an *anterior surface*, lying above the ridge joining the *processus brevis* and the *processus longus*, and extending to the angle made by the head of the malleus with the neck, and separated from the posterior surface by a sigmoid-shaped

¹ Caelius Folius, Venice, 1645. *Nova auris internæ delineatio*.

ridge for the insertion of the ligamentum mallei externum of Helmholtz; and the *posterior surface*, which lies between the aforesaid sigmoid ridge in front, the edge of the articulating surface of the malleus above, the low, long process behind, and a line drawn from the insertion of the tensor tympani to the short process below. Of all the surfaces of the neck, the posterior glides most gradually into the manubrium. The *handle* or the *manubrium* of the malleus, that part of the bone inserted into the membrana tympani, has also three surfaces, which may be considered prolongations downward of those of the neck. Since they all gradually approach one another and are united in the lower pointed end of the manubrium, the latter may be said to resemble a three-sided bayonet, one ridge of which passes from the short process directly downward to the tip, and is consequently turned towards the external auditory canal. The point or lower end of the handle of the malleus is flattened into a small disk, one surface of which is turned towards the auditory canal. This spot is plainly visible as the pale, round centre of the umbo.

The long axis of the handle of the hammer is convex posteriorly and inward, so that when viewed from without the manubrium appears concave on its anterior and outer surfaces. This is especially marked at the lower third on the anterior surface, so that the manubrium normally appears curved decidedly forward near its lower end, of course in the plane of the membrana tympani. Along the ridge of the manubrium, directed towards the external auditory canal, several little node-like prominences are not uncommonly seen. These are not pathological, but purely physiological. Their origin is obscure.

Dimensions of the Malleus.—The malleus is nearly nine millimetres long; its manubrium is between four and five millimetres long, and its head is two and one-half millimetres thick. The latter is the greatest diameter of any part of the bone, which gradually tapers to the point of the handle.

The long diameter of the articulating surface of the malleus is about three millimetres; the short diameter is between one and one-half and two millimetres.

Fixation of the Malleus.—The malleus is held in position by four ligaments,—viz., the ligamentum mallei anterius, ligamentum mallei superius, ligamentum mallei externum, and ligamentum mallei posterius. The *ligamentum mallei anterius* is a broad band of fibres which holds the processus Folianus against the spina tympanica major. This ligament may be said to arise from the spina tympanica major, and to be inserted along the neck of the malleus all the way from the processus Folianus to the head of the malleus. A part of it also runs from the processus Folianus to the short process of the malleus below and the membrana tympani above, aiding thereby the division between the anterior and posterior pockets of the membrana tympani; another fold of the same ligament runs from the processus Folianus downward with a free margin as far as

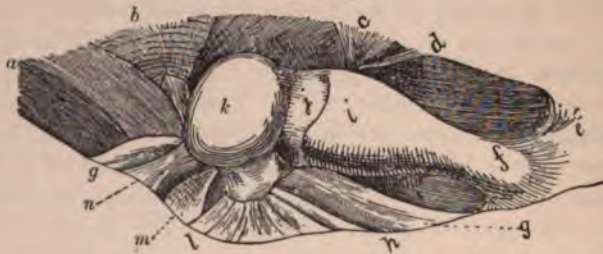
the line corresponding with the insertion of the tensor tympani muscle. This aids in making the limiting wall between the anterior pocket of the drum-head and the tympanic cavity (Fig. 26).

The round *ligamentum mallei superius* descends obliquely downward and outward from the tegmen tympani to the head of the hammer. Its function is to prevent the malleus from being forced outward.

The *ligamentum mallei externum* is a very important collection of satin-like, tendinous fibres, which radiate from the sigmoid crest on the front of the neck of the hammer and are inserted into the sharp edge of the segment of Rivinus on the temporal bone. It prevents the hammer from being forced inward, and, being inserted above the axis of rotation of the hammer, it prevents the manubrium, which is below the axis of rotation, from moving too far outward towards the auditory canal (Fig. 26).

The *ligamentum mallei posticum* is really the posterior edge of the ligament just described as the external ligament of the hammer. As the line followed by this bundle of fibres passes through the spina tympanica major, and as it represents pretty closely the axis of rotation of the hammer,

FIG. 26.



Ligamentous support of the ossicles viewed from above. (Helmholtz.) *l-h*, attachment of the *ligamentum mallei externum*; *k*, head of hammer; *i*, body of incus; *f*, point of its short process; *a*, entrance to the Eustachian tube from the tympanum; *c*, stapes; *d*, tendon of the stapedius muscle; *b*, tendon of the tensor tympani, leaving the cochlear process; *g-g*, chorda tympani, marking the free edge of the fold of mucous membrane, bounding the pouches; *n*, upper tendinous fibres of the *ligamentum mallei anterior*, originating above the spina tympanica major, *m*; *j*, malleo-incudal joint.

Helmholtz has suggested that it should be considered a separate ligament, and has given to it the name it bears. As this ligament and the *ligamentum anterior* are in a mechanical sense one ligament, although the hammer intervenes between them, Helmholtz has called the two sets of fibres the axis-ligament of the malleus (Fig. 26).

Axis-Ligament of the Malleus.—The plane of this ligament is not quite horizontal, being a little higher in front than behind.

In all its motions as a lever the hammer swings about this axis-ligament as a fixed point. All above the short process of the malleus is above, and all below the short process is below, the axis-ligament.

The *ligamentum mallei anterior* of Arnold was once described as a mus-

cle, the laxator tympani major.¹ It is not, however, anything more than a ligament which originates from the spina angularis of the sphenoid, passes through the petro-tympanic fissure,² and is inserted into the malleus.

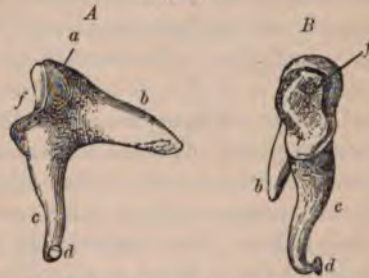
Under the name *ligamentum mallei posticum seu manubrii*, the *ligamentum mallei externum* of Arnold, Lincke describes a ligament which passes from the upper edge of the end of the external auditory canal to the short process of the malleus, and occupies the position of a supposed muscle, once called the *M. laxator tympani minor*, or *M. mallei exterior seu Casserii*. It is now universally acknowledged that muscular fibres do not exist here.³

Incus, or Anvil.—The middle one of the three auditory ossicles is the incus, or anvil. The name is derived from the shape of its upper half. This small bone is divided into a body and two processes,—viz., a short and a long one. The former of these two processes is also called the horizontal process. It is held to the posterior and to the upper wall of the tympanic cavity by ligaments.⁴ This is an important point in the mechanism of the auditory ossicles.⁵ The longer process is also called the descending ramus of the incus (Fig. 27, *c*). It curves gradually outward,—i.e., towards the external ear, away from the vertical plane of the body of the incus, assuming a slight sigmoid shape; at its tip it curves rather sharply inward, to unite with the head of the stapes by means of the processus lenticularis (Fig. 27, *d*).

The narrowest part of the incus is at the middle of the body of the bone; beneath this part it widens out again anteriorly into the important tooth which locks with the malleus in all its inward movements, and posteriorly into the descending ramus or long process. The articulation between the malleus and incus is a true joint, in which is found a meniscus.⁶

If this articulation is viewed on its outer surface,—i.e., on that side towards the external auditory canal,—it would seem that the incus quite overlapped or embraced the head of the malleus; when viewed from its

FIG. 27.



Right incus; magnified four diameters. (Henle.) *A*, inner surface; *B*, view in front: *a* *b*, body; *b*, short process; *c*, long process; *d*, processus lenticularis; *f*, articular surface for the head of the malleus.

¹ Sömmering.

² Glaserian fissure.

³ Henle, *Eingeweidelehre*, S. 745.

⁴ *Ligamentum incudis posterius et ligamentum incudis superius*.

⁵ Henle calls this the incus-tympanic joint (Fig. 29, *d*), "an amphiarthrosis between the articulating surface of the short process of the incus, and a prominence on the posterior wall of the tympanic cavity. The articulating surface on the incus is covered with a thin layer of fibrous cartilage."

⁶ Rüdinger.

tympanic side, however, it appears that the largest share in the joint belongs to the malleus. This is due to the wonderfully peculiar structure of this joint, the true nature and function of which were first pointed out and explained by Helmholtz in 1869.¹

Dimensions of the Incus.—The greatest length of the incus is in a vertical line passing from the top of the body of the bone through the long process. It measures seven millimetres. The horizontal upper edge of the body measures five millimetres. The greatest thickness—two and one-half millimetres—is at its articulating surface for the malleus.

Malleo-incudal Joint.—Before Helmholtz's investigations, the shape of this articular surface was usually described as resembling a saddle. In order to gain a clearer idea of the mechanism of this joint, Helmholtz makes use of a different comparison. "It is, in fact, like the joint used in certain watch-keys, where the handle cannot be turned in one direction without carrying the steel shell with it, while in the opposite direction it meets with only slight resistance. As in the watch-key, so here, the joint between hammer and anvil admits of a slight rotation about an axis drawn transversely through the head of the hammer towards the end of the short process of the anvil; a pair of cogs oppose the rotation of the manubrium inward, but it can be driven outward without carrying the anvil with it."² It is of the kind of joint known as ginglymus. The mechanism of this joint is best understood when it is known that the malleus, as a whole, is a lever, the fulcrum of which passes just below the short process. This, of course, leaves the head and neck—*i.e.*, the articulating surfaces for the malleo-incudal joint and all the free tympanic parts of the malleus—above the line of support of the lever, the manubrium being below. The latter is the long arm of the lever, and consequently all its movements are repeated in an opposite direction on the head of the malleus. Each inward movement of the manubrium, therefore, causes a slight outward motion in the head of the malleus and a firm locking of the malleo-incudal joint, by which the incus is carried about an axis drawn transversely through the head of the hammer towards the end of the horizontal or short process of the incus. The incus being also suspended as a lever about the line just named, when all above that line moves outward, all below the line moves inward,—*i.e.*, as the upper part of the incus is moved outward the long process swings inward and carries the stapes ahead of it, thus forcing the foot-plate of the latter into the oval window.

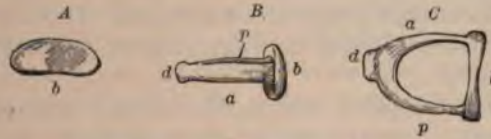
The Stapes, or Stirrup.—The smallest bone in the body and the innermost of the three auditory ossicles is the stapes, or stirrup. Its name is

¹ *Mechanik der Gehörknöchelchen und des Trommelfells*, Bonn; also Pflüger's *Archiv f. Physiologie*, 1 Jahrgang.

² Helmholtz's *Mechanism of the Ossicles of the Ear*, etc., English translation by Buck and Smith, 1873, p. 33.

derived from the striking resemblance it bears to a stirrup. It is divided into a head, or capitulum, a neck, two branches, or legs (crura), and a foot-plate, or base (Fig. 28).

FIG. 28.



Right stapes; magnified four diameters. (Henle.) *A*, from within; *B*, from in front; *C*, from beneath; *b*, foot-plate, or base; *d*, capitulum, or head; *a*, anterior; *p*, posterior shaft or crus of stapes.

The *head*, which is like a cup-shaped button, is placed at the junction of the two *crura*. It is designed for the reception of the processus lenticularis of the incus, with which it forms a ball-and-socket joint. There is a meniscus in this joint, according to Rüdinger.¹ On the posterior surface of the head of the stapes the stapedius muscle is inserted.

The two *crura*, or *branches*, are furrowed on their inner surface, which makes them lighter, yet does not deprive them of strength. They arise from the *base*, forming a graceful arch, and unite above in the *head*, as already stated.

The *foot-plate* of the stapes is oval or slightly kidney-shape, thicker at the periphery than in the centre, is slightly convex towards the vestibule, and concave on its tympanic surface; it fits into the oval window, where it is held by a fibrous packing. This permits of a slight inward and outward movement on the part of the base of the stirrup. When the stapes is in position, the long axis of its base is horizontal and coincides with that of the oval window. In this position its convex edge looks upward, and its concave edge, which gives it its slight kidney-shape, looks downward (Fig. 28, *A*).

The *ligamentum obturatorium stapedis* is a thin membrane stretching across the space between the base and the *crura*; it is attached to the crista of the former and the furrow on the inner edges of the latter.²

Dimensions of the Stapes.—The stapes measures nearly four millimetres from its head to the under surface of the foot-plate. The latter is two and a half millimetres long in its horizontal diameter, one millimetre in its vertical diameter (the bone, of course, must be imagined in normal position), and about one-fourth of a millimetre thick at its edges. It is slightly concave towards its centre.

Joint between the Base of the Stirrup and the Oval Window.—According

¹ Virchow's Archiv, 1860, Bd. xx. Monatsschr. f. Ohrenh., January, 1873.

² Rüdinger, Atlas of Osseous Anatomy of the Human Ear, edited by C. J. Blake, Boston, 1874, p. 9.

to Helmholtz,¹ the base of the stapes is surrounded at its edge by a lip of fibro-elastic cartilage seven-tenths of a millimetre thick. The union between the base of the stirrup and the wall of the labyrinth appears to be formed by means of the periosteum of the vestibule, extended over the base of the stapes (Henle), but the fibrous lip on the edge of the base of the stirrup is not attached to the fenestra ovalis. The mucous membrane of the tympanic cavity extends over the outer or tympanic surface of the base of the stapes.

Gustav Brunner² regards the malleo-incudal and incudo-stapedial joints as a variety of symphysis or synchondrosis. He is disposed to regard the connections between the ossicula auditus not as true or ordinary joints. As described by him, they are all of peculiar construction, since between the cartilaginous surfaces of the bones there is a fibrous or fibro-cartilaginous intermediate substance.

Rüdinger³ reasserted the true joint-like structure of the articulations of the ossicula. He also maintained his view that in both the malleo-incudal and incudo-stapedial joint there is a fibro-cartilaginous disk connected with the capsular ligament, but not

with the hyaline covering of the articular surfaces of the bones.

The Tympanum.—The tympanic cavity is about half an inch in height and width and a line or two deep, measuring from within outward. It is lined with mucous membrane, which is reflected over all the tympanic contents, and is a continuation of that of the throat, nose, and Eustachian tube. The drum-cavity lies entirely within the temporal bone, and is bounded by a roof and floor and the four walls.

The *roof*, or tegmen tympani, is the boundary between the base of the brain and the tympanum. This osseous partition is very thin, and in some cases congenital fissures in it persist; in such instances the only boundary at the dehiscences, between the tympanum and the cerebral cavity, is formed by

the mucous membrane of the former and the membranes of the brain. It is evident that in such cases pathological processes in the drum-cavity are especially liable to pass upward to the brain.

FIG. 29.



Right tympanic cavity viewed from above; malleo-incudal and incudo-tympanic joints; magnified two diameters. (Henle.) *c*, head of malleus; *e*, short process of incus; *f*, tendon of tensor tympani muscle; *d*, capsule of incudo-tympanic joint; *a*, ligamentum mallei anterius; *b*, chorda tympani.

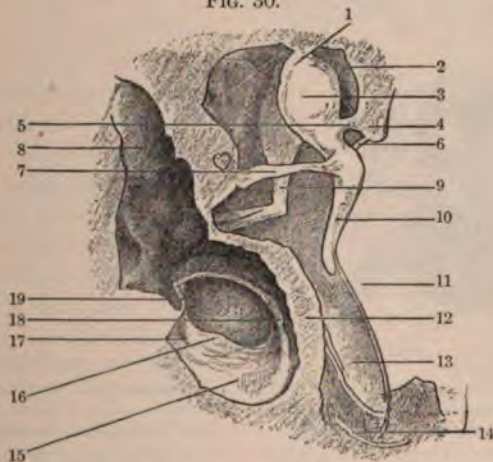
¹ Op. cit., pp. 34, 35.

² Ueber die Verbindung der Gehörknöchelchen, namentlich, des Hammer-Amboßgelenks, Vorläufige Mittheilung. M. f. O., No. 1, 1872.

³ Ueber die Gelenke der Gehörknöchelchen, M. f. O., No. 3, 1872.

The Malleo-incudal Joint and Surrounding Parts viewed from Above.—If the tegmen tympani be removed, let us say, from the *right* tympanic cavity, the malleo-incudal joint and the incudo-tympanic joint will be laid bare, and just in front of the head of the malleus, but below it, will be seen the tendon of the tensor tympani muscle coming upward and inward from the left, to be inserted into the tubercle on the neck of the hammer. Above this tendon, winding from within outward and to the right, around the neck of the malleus, is seen the chorda tympani on its way to the Glaserian fissure. Of course, this picture is to be reversed for the left ear. The suspensory ligament of the malleus is attached to the roof of the tympanic cavity (Fig. 30, 1).

FIG. 30.



Partial view of left drum-cavity and aditus from in front; the lowest portion of the cochlea, vestibule, and superior semicircular canal laid open by a vertical incision passing through the long axis of the latter. (Siebenmann.) 1, superior ligament of the malleus; 2, malleo-incudo-squamous space or attic; 3, head of the malleus; 4, margo tympanicus; 5, external ligament of the malleus; 6, membrana flaccida; 7, tendon of the tensor tympani; 8, superior semicircular canal; 9, long crus of the incus; 10, handle of the malleus; 11, auditory canal; 12, promontory; 13, tympanic cavity; 14, floor of the drum-cavity; 15, floor of the scala tympani (of the cochlea); 16, crista semilunaris (of the round window); 17, inner opening of the aquæductus cochleæ; 18, lamina spiralis secundaria; 19, fixation-point of the removed lamina spiralis primaria.

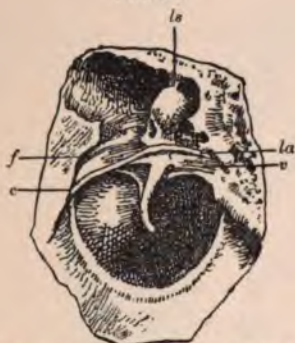
The Attic, or Recessus Epitympanicus.—The removal of the tegmen tympani reveals the so-called attic, or recessus epitympanicus. The space is bounded above by the tegmen tympani, below by a plane run horizontally through the neck of the malleus, in front by the vertical plane passing through the processus cochleariformis for the tendon of the tensor tympani, and behind by the aditus ad antrum. Its inner boundary is the upper part of the inner wall of the middle ear above the promontory and plane of the tensor tympani, and its outer boundary is composed of the tympanic process or "scute" of the squama above and

the membrana flaccida below. Its cavity is occupied chiefly by the head and neck of the malleus and the body of the incus (Fig. 30, 2).

The Floor of the Tympanum.—The floor of the tympanum is not much more than a groove between the outer and inner wall. It is below the lower periphery of the drum-head, the opening of the Eustachian tube, and the opening into the mastoid cells. It is entirely within the boundary of the petrous portion of the temporal bone and over the jugular fossa.

The Outer Wall of the Tympanum.—The outer wall of the tympanic cavity is composed mainly of the membrana tympani. The bony framework of the annulus tympanicus around the membrana tympani constitutes the limit of the outer wall of the tympanum. In connection with the outer wall—*i.e.*, in it or on it—we find the manubrium mallei, the chorda

FIG. 31.



Inner surface of the left membrana tympani (outer wall of tympanic cavity) and the attic, with the malleus head suspended in it. (Politzer.) *la*, suspensory ligament of the malleus; *f*, fold of the posterior pouch of the membrana tympani; *v*, fold of the anterior pouch of the membrana tympani, and the anterior ligament of the malleus; *la, c*, chorda tympani nerve.

FIG. 32.



Diagrammatic representation of the formation of the so-called pouches of the membrana tympani. 1, mucous membrane of head of malleus; 2, reflection of same over chorda tympani nerve; 3, a pouch of the membrana tympani; 4, 4, inner surface of membrana tympani; 5, section through osseous floor of tympanic cavity; 6, umbo of membrana tympani; 7, short process of malleus.

tympani, and the duplicature of mucous membrane about it, which also forms the inner boundary of the so-called pockets of the membrana tympani.

The pockets or pouches of the membrana tympani are the spaces lying between the upper part of the membrana tympani and the duplicature of mucous membrane around the chorda tympani nerve, in the so-called horizontal portion of its passage through the tympanic cavity. After the mucous membrane of the tegmen tympani has been reflected over the chorda tympani, it ascends again to reach the upper edge of the drum-membrane, in order to form the inner or mucous layer of the latter. Thus it is that the chorda tympani is found at the free edge of a fold of mucous membrane, which, with the membrana tympani lying farther outward, forms a space or pocket open below. This space or groove lying

between the aforesaid fold and the drum-membrane, by reason of the clinging of the chorda tympani to the inner surface of the neck of the malleus, is divided into two spaces,—an anterior, the smaller, and a posterior, a larger one,—called, respectively, the anterior and posterior pouch or pocket of the drum-membrane. They were first described by von Troeltsch, in 1856, and are situated on the inner edge of the upper part of the drum-head (Fig. 32, 3).

The *posterior* pouch lies between the malleus and the posterior periphery of the membrana tympani. The shape of the posterior pouch is triangular or tent-like, the apex of which is directed inward and its base outward. It is about three millimetres high and four millimetres broad. This pouch is best seen when the inner side of the drum-head is viewed, but it can also be seen from the outer side when the drum-head is thin and properly illuminated.

The *anterior* pouch lies in front of the malleus, and is smaller than the posterior pouch. Its inner wall is composed of mucous membrane only. It is not so well marked as that of the posterior pouch, but contains "all the parts which proceed from or enter the Glaserian fissure." The anterior is much lower and shorter than the posterior pouch.

There is a third pocket or pouch of the membrana tympani described by Prussak¹ and Gustav Brunner² (Fig. 33, *i*). This cavity is bounded behind by the neck of the malleus, below by the upper surface of the short process of the hammer, in front by the membrana flaccida, and

FIG. 33.



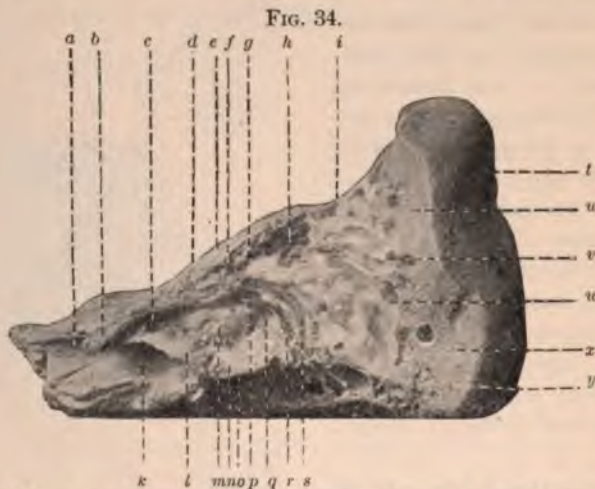
Section through the long axis of the malleus at right angles to the membrana tympani, from an adult. (Brunner.) *k*, bony ridge at the upper segment of the drum-head (the segment of Rivinus, according to Helmholtz); *g*, head of malleus; *p*, neck of malleus; *o*, handle of malleus; *l*, short process; *j*, membrana flaccida; *h*, ligamentum mallei externum; *m*, chorda tympani; *n*, tendon of tensor tympani; *i*, a cavity, according to Prussak; *a*, cartilage; *b*, *b*, fibres of membrana tympani; *c*, dermoid layer of membrana tympani; *d*, membrana propria; *e*, Haversian canals.

¹ Archiv für Ohrenheilkunde, Bd. iii.

² The Connections between the Ossicles of Hearing, Archives of Oph. and Otol., 1874, vol. iii. pp. 145-172.

above by a ligamentous band, the ligamentum mallei externum, which is inserted between the margo tympanica and the spina mallei. The cavity is separated from the anterior tympanic pouch by the upper blind end of the latter; posteriorly, it communicates with the tympanic cavity by a good-sized opening, above the position of the posterior tympanic pouch. This pouch, being thus placed in communication with the tympanum, may become filled with mucus or pus, and may, in consequence, be ruptured.

Many cases of earache which present no features of distention of the drum-head proper nor, in fact, of the region of the membrana flaccida



Inner wall of the left tympanic cavity, natural size; photograph from nature. *a*, mouth of Eustachian tube; *b*, belly of tensor tympani muscle; *c*, tendon of same above tympanic mouth of Eustachian tube; *d*, middle cranial fossa; *e*, tegmen tympani; *f*, recessus epitympanicus, or attic; *g*, aditus ad antrum; *h*, tympanic antrum; *i*, middle cranial fossa; *k*, carotid canal; *l*, anterior wall of tympanic cavity; *m*, promontory, inner tympanic wall; *n*, floor of tympanic cavity; *o*, jugular bulb; *p*, stapes in oval window; *q*, round window; *r*, stapedius muscle in its cone, latter laid open; *s*, Fallopian canal laid open; *t*, upper part of outer mastoid surface; *u*, section of mastoid cortex; *v*, *w*, mastoid cells; *x*, mastoid cortex; *y*, mastoid process.

may be relieved instantly by puncturing the latter at the third pouch. The point of the puncturing in such cases is just above and in front of the short process.

As a general rule, when there is severe earache, attended only by redness of the flaccid part of the drum-head, and neither congestion nor bulging of the drum-head proper, a cut into the congested flaccid part will relieve the suffering. Mucus or pus will usually escape; sometimes only blood.

The Inner Wall of the Tympanum.—On the inner wall of the tympanic cavity there is found a convexity, the promontory caused by the projection outward at that point of the lower turn of the cochlea (Fig. 34, *m*). This eminence is usually seen through the membrana tympani as a pale

yellowish spot. At this point the inner and outer walls of the tympanum are closest to each other. Above the promontory, in a depression named the *fossula fenestræ ovalis* (Rüdinger), is the oval window, *fenestra ovalis*, which receives the foot-plate of the stapes (Fig. 34, *p*). Behind the promontory is the niche in which is found the round window, *fenestra rotunda* (Fig. 34, *q*). The long diameter of the oval window is three millimetres and its short diameter 1.7 millimetres. The diameter of the round window is two millimetres. A ridge starts above the oval window and curves backward and downward behind the promontory and round window. This ridge is the posterior limit of the inner wall of the tympanum, and marks the position of the canal for the facial nerve (Fig. 34, *s*), which escapes from the tympanum at the stylomastoid foramen. The course of the facial nerve to the ear will be considered farther on.

Eminentia Stapedii.—Behind, and a little below the line of the oval window, is a bony eminence, the *eminentia stapedii* (Fig. 34, *r*). This little conical eminence is hollow and contains the stapedius muscle, to which it gives origin. The tendon of this muscle, after passing through a small opening in the apex of the eminence, runs a little upward and forward, forming an obtuse angle with the long axis of the muscle, and is then inserted into the edge of the articular surface of the head of the stapes.¹ The stapedius muscle is supplied with a branch from the facial nerve (Fig. 35, *ms*).

Function of the Stapedius Muscle.—According to Henle,² it is probable that the stapedius muscle serves to hold the stapes in a firm position rather than to move it, and that it acts only when there is danger that an undue force communicated to the malleus will be conveyed to the stapes by means of the intervening incus. Its action then is to prevent the stapes from being forced into the oval window, and also to antagonize the tensor tympani muscle.

Fixator Baseos Stapedis.—Rüdinger has described an organic muscular structure on the tympanic surface of the stapes, which he calls the *fixator baseos stapedis*. It arises from a small bony ridge (diameter 0.8 millimetre), situate one millimetre from the upper and posterior circumference of the oval window, and is inserted into the angle formed by the

FIG. 35.



Posterior part of the inner tympanic wall, with the posterior wall partly dissected; twice the natural size; right ear. (Politzer.) *st*, stapes; *cs*, head of the stapes; *ms*, stapedius muscle in its canal and its tendon inserted at the neck of the stapes; *p*, promontory; *f*, facial nerve in the descending part of the facial canal; *v*, artificial opening into vestibule.

¹ Henle.² Eingeweidelehre, S. 749.

leg of the stapes and its somewhat projecting foot-plate. It is supposed to be an antagonist of the voluntary muscle, the stapedius.¹

Topographical Relation of the Stapedius Muscle to the Facial Nerve.—In the fœtus only the upper part of the stapedial cavity is separated from the facial canal by bone, the lower part having free communication with the canal.² At this point the soft tissues surrounding the muscle and the nerve are in contact. In the adult, however, the communication between the bony cavity containing the muscle and the facial canal is less free, being effected by means of one or more small openings or by one long, slit-like aperture from three to five millimetres long and one-half millimetre wide. Transverse sections of this muscle show that it is a triangular prism; longitudinal sections show that its general form is pear-shaped.

The oval window is separated from the round window by the tract of bone corresponding to the posterior surface of the promontory. They are about two millimetres apart. The plane of the former looks outward, and is nearly vertical in its position; that of the latter looks backward and downward. The oval window is the entrance to the vestibule and mediately to the cochlea. The round window is an exit from the cochlea into the tympanic cavity. This window, however, in its normal state, is hermetically closed by a membrane, the *membrana tympani secundaria*, or *membrana fenestræ rotundæ*.

Well forward, on the inner wall, towards the tympanic opening of the Eustachian tube, are the *processus cochleariformis*, the spoon-shaped tympanic end of the *septum tubæ*, which separates the Eustachian tube from the bony furrow containing the tensor tympani muscle, and the tendon of the latter as it passes to the malleus (Fig. 36, *d*). The *processus cochleariformis* is the fulcrum over which the tendon of the tensor tympani plays.

Tensor Tympani Muscle.—This muscle originates from the anterior mouth of the *canalis musculo-tubarius* of the pyramidal portion of the temporal bone, the upper wall of the cartilage of the Eustachian tube, and from that small portion of the sphenoid bone which joins the temporal bone, the *processus angularis*. The muscle then passes over the *septum tubæ* and enters the semi-canal tensoris tympani³ (Fig. 34, *a*, *b*, *c*). Its tendon passes over the *processus cochleariformis*, and, turning outward, crosses the tympanic cavity at right angles to the belly of the muscle, to be inserted into the malleus (Fig. 36, *d*). The tensor tympani is connected with the dilatator tubæ, or tensor palati, by both tendinous and muscular fibres, as shown by Kessel, Rüdinger, Mayer, Rebsa-

¹ Das häutige Labyrinth, by Rüdinger, Stricker's Handbuch, 1872, Ss. 912, 913.

² Politzer, Zur Anatomie des Gehörorgans, I. Ueber das Verhältniss des Musc. Stapedius zum nervus facialis; II. Ueber den Processus Styloideus, Archiv f. Ohrenh., Bd. ix. S. 158.

³ This canal is not always perfectly closed, and hence it has been called the semi-canal tensoris tympani.

men, and others. The motor nerve of the tensor tympani is derived through the otic ganglion¹ from the motor root of the trigeminus.²

The tensor tympani muscle has been described as a penniform muscle,³ in allusion to its appearance, due to the fact that the muscular fibres arise from the periosteum of the upper wall of the bony canal in which the muscle lies, and pass into the tendon which lies on the under edge of the muscle; the latter is turned towards the floor of the canal. As the fibres of the muscle are short, a large portion of the tendon is within the canal, where the muscle is covered by a periosteal sheath that is continued over the free portion of the tendon, crossing the tympanic cavity, and is there covered with mucous membrane.

The transverse section of a perfect tensor tympani muscle measures 2.75 millimetres, the length of its tendon from the processus cochleariformis to the insertion into the malleus is 2.25 millimetres, and the length of the muscle from its extreme origin in the Eustachian tube to the turn of the processus cochleariformis is 2.2 centimetres, somewhat more than an inch, as shown by Weber-Liel. The tendon of the tensor tympani is inserted on the anterior surface of the inner edge of the manubrium rather than on its posterior surface; hence traction inward of the muscle will cause a rotation of the malleus about its long vertical axis, and thus twist the posterior surface of the handle of the malleus outward, and with it the posterior segment of the membrana tympani. It therefore often seems, in certain pathological retractions of the malleus, that the anterior segment of the membrana tympani is sunken and the anterior outline of the manubrium especially prominent.

Anterior and Posterior Walls of the Tympanic Cavity.—The most important point in the anterior wall is the tympanic opening of the Eustachian tube, situated considerably above the floor of the tympanum, an arrangement which often produces a retention of small amounts of fluid in the cavity (Fig. 34, l).

Fig. 36.



Left auditory apparatus viewed from above; tegmen tympani and upper part of the labyrinth removed; natural size, from photograph. *a*, internal auditory canal, for auditory nerve; *b*, cochlea cut through its modiolus; *c*, membrana tympani; *d*, cochlear process for tendon of tensor tympani passing to the membrana; *e*, malleo-incudal joint; *f*, mastoid process, outer surface; *g*, upper mastoid cells; *h*, middle cranial fossa, outer back part; *i*, vestibule; *k*, section through posterior semicircular canal; *l*, aditus ad antrum; *m*, mastoid cells; *n*, antrum.

¹ Henle, *Eingeweidelehre*, S. 747.

² Ludwig and Politzer, *Meissner's Jahresbericht*, 1860, S. 583. ³ Helmholtz.

In the *posterior* wall of the tympanic cavity is situated the important opening communicating with the mastoid antrum, and by that means with the mastoid cells. The *tympanic* or *mastoid antrum* is a cavity of irregular shape, the roof of which is a continuation backward of the tegmen tympani (Fig. 34, *h*, and Fig. 36, *n*). It is formed by a hollowing out of the base of the pyramidal part of the temporal bone, which is joined to the mastoid portion at the upper part of the latter. This cavity may extend forward into the root of the zygomatic arch and downward into the mas-

FIG. 37.



Cast of the soft parts of the middle ear, viewed from without; the cartilaginous portion of the Eustachian tube is not included. (Siebenmann.) 1, attic of the drum-cavity in front of the plica transversa; 2, plica transversa; 3, posterior superior horizontal cells; 4, large solitary cell, including nearly all the mastoid process; 5, handle of the malleus; 6, cells on the floor of the Eustachian tube; 7, large penniform cell of the inner wall of the Eustachian tube; 8, isthmus of the Eustachian tube.

toid cells. It communicates with the tympanum by means of a wide opening, the under edge of which is about on a level with the oval window.

The floor of the tympanic cavity rises backward to meet this opening, in the same way as it rises anteriorly to the opening for the Eustachian tube (Fig. 37, 1-4).



Nerve foramina at the fundus of the internal auditory canal. (Quain.)

Course of the Facial Nerve.—Although the facial canal has been already mentioned in connection with the inner wall of the tympanum, further attention should be given at this point to the course of the facial nerve.

and the important relations it sustains to the structures in the posterior portion of the tympanum and to the mastoid cells.

The *facial canal* rises at the fundus of the internal auditory canal (Fig. 38), and after leaving it, it passes somewhat in front of and farther out-

ward than it, between the cochlea and the semicircular canals, above the roof of the vestibule (Fig. 39, *a-g*). Upon reaching the plane of the inner wall of the tympanic cavity, it turns¹ suddenly backward at right angles to its former course, and, running above the position of the oval window, curves gradually backward and downward, to escape from the tympanic cavity at the stylomastoid foramen in the postero-exterior surface of the petrous bone (Fig. 34, *s*). In the anterior wall of the facial canal, very near the stylomastoid opening, is a small foramen leading to the *canalis chordæ*, which, leaving the facial canal, runs upward and forward through the substance of the petrous bone to the tympanum, in the lower external corner of which it opens.

Greater Superficial Petrosal Nerve.—

The greater superficial nerve, one of the posterior branches of the sphenopalatine, or Meckel's ganglion, runs in a groove on the posterior surface of the petrous portion of the temporal bone, and, entering the hiatus Fallopii, passes along the Fallopian or facial canal to the geniculate ganglion (Fig. 39 *n, g*) of the facial nerve. Strictly speaking, this nerve runs from the facial nerve to the sphenopalatine ganglion, forming its motor root. (Gray.) The other nerves joining the geniculate ganglion are the small superficial petrosal, from the otic ganglion, and the external superficial petrosal, from the sympathetic on the middle meningeal artery.

Lymphatic Cavity in the Facial Canal.—On the inner side of the facial canal, Rüdinger² has described an empty space lying between the nerve-trunk and the periosteum. The supposition is that this space marks an extension of the arachnoidal sac of the brain into the canal of the facial nerve, and is similar to that which is known to accompany both the optic and the acoustic nerve; it may therefore be regarded as a lymph cavity.

The Chorda Tympani Nerve.—The chorda tympani has always been described as a branch of the facial nerve, though there is much to lead to a doubt that it has such an origin. It may be a separate nerve.

Nerves supplying the Mucous Membrane of the Tympanic Cavity.—The nerves supplying the mucous membrane of the tympanic cavity, as well



FIG. 39.
Tympanic cavity after removal of the tegmen tympani and some of the bone anteriorly and interiorly; course of facial nerve; left side. (Politzer.) *ha*, malleo-incudal joint; *t*, tensor tympani muscle; *s*, tendon of the tensor tympani passing across the tympanum; *f*, facial nerve; *a*, auditory nerve; *g*, geniculate ganglion; *n*, greater superficial petrosal nerve; *an*, mastoid or tympanic antrum.

¹ *Genu canalis facialis*, at which point the canal for the great superficial petrosal nerve joins the facial canal. (Henle.)

² Ueber den canalis facialis in seiner Beziehung, zum siebenten Gehirnnerven beim Erwachsenen, M. f. O., 1873, No. 6.

as that of the Eustachian tube and mastoid cells, are derived from the tympanic nerve, also called the tympanic plexus, an anastomosis between the otic ganglion, petrosal ganglion of the glossopharyngeal nerve, and the carotid plexus, by means of the superior cervical ganglion of the sympathetic nerve.¹



FIG. 40.
Nerves in and about the tympanum. (Heath.) 1, sensory portion of the fifth nerve with Gasserian ganglion; 2, tensor tympani muscle; 3, motor portion of the fifth nerve passing beneath the ganglion; 4, malleus; 5, small superficial petrosal nerves of Arnold; 6, incus; 7, otic ganglion; 8, facial nerve; 9, chorda tympani; 10, membrana tympani; 11, tensor palati muscle; 12, middle meningeal artery; 13, lingual nerve; 14, auriculo-temporal nerve; 15, inferior dental nerve; 16, pterygoideus externus; 17, pterygoideus internus; 18, internal maxillary artery; 19, mylohyoid nerve.

The *otic ganglion* (Arnold's) (Fig. 40, 7) is situated on the inner side of the sensory division of the inferior maxillary nerve, and sends several small branches to it. From the otic ganglion emanates also the small petrosal nerve that joins the facial nerve and the tympanic branch of the glossopharyngeal nerve (Fig. 40, 5). The tympanic nerve, furthermore, sends branches which anastomose with the smaller and greater petrosal nerves. The latter branch is also in connection with Meckel's ganglion. The external petrosal nerve is in connection with the sympathetic nerve on the middle meningeal artery. It is important to bear these relations in mind when considering certain neuralgias in and about the ear, which might otherwise prove very puzzling.

Numerous cases of earache are constantly seen which are solely due to imperfect teeth. This may be explained by the fact that by means of the otic ganglion, the soft palate, the drum-head, and the tensor tympani muscle, the lining membrane of the cavity of the tympanum, the integument of the external ear, and the teeth are put in sympathetic relation with one another.

Perhaps certain epileptiform phenomena which have been observed in connection with well-marked disease of the middle ear, as well as similar phenomena which could be seen to be connected with disease of the external ear, may be explained by reflex communication through the tympanic plexus.

The *tympanic nerve*, or *Jacobson's nerve*, is a branch from the petrosal ganglion² of the glossopharyngeal nerve; "it enters a small bony canal on the base of the petrous portion of the temporal bone (Fig. 13), ascends to the tympanum, enters this cavity by an aperture in its floor close to

¹ Bischoff, *Microscopische Analyse der Kopfnerven*, München, 1865.

² Andersch.

the inner wall, and divides into three branches, which are contained in grooves upon the surface of the promontory."¹ This is the largest nerve-branch given to the tympanic cavity, and therefore it has received its special name and consideration. Since, however, the tympanic nerve contains so large a number of large ganglion cells, either solitary or grouped, and thus makes numerous connections with other important ganglia and nerves, the name *tympanic plexus* is now given to what formerly was called, in its tympanic portion at least, the tympanic nerve.

Blood-vessels of the Tympanic Cavity.—The chief artery of the tympanic cavity runs along the floor of the tympanum and over the promontory.

According to Gray, the arteries supplying the tympanic cavity are as follows: the *tympanic* branch of the *inferior maxillary*, which is given to the *membrana tympani*, the *stylomastoid* branch of the *posterior auricular*, distributed to the back part of the *tympanic cavity* and *mastoid cells*, a number of smaller branches from the *petrosal* branch of the *middle meningeal*, and branches from the ascending pharyngeal and internal carotid. The *veins* of the tympanic cavity terminate in the *middle meningeal* and *pharyngeal veins*, which form a plexus near the glenoid articulation, and then empty into the *internal jugular vein*.

Zuckerkandl² has described an artery which he has termed the *arteria stapedia*. This artery is a branch of the stylomastoid artery, that enters the tympanum through an ever-present triangular opening in that part of the facial canal just above the fenestra ovalis. This small vessel descends through the *membrana obturatoria* of the stapes, either to anastomose with a branch of the artery following Jacobson's nerve or to break up into secondary anastomoses before it reaches this point. Before the artery passes the stapes it gives off a branch to the anterior crus of the stapes and to the anterior part of the *membrana stapedia*, which it divides in two, a second branch to the hinder crus and to the posterior part of the stapedial membrane, and a third arteriole, usually from one of the lateral branches, passes inward to the foot-plate of the stapes.

PHYSIOLOGY.

The function of the tensor tympani muscle is somewhat like that of the palmaris,³—*i.e.*, better adapted for tension than for motion. It also appears that, by exerting a slight tension on the *membrana tympani*, this muscle can bring about a muffling or damping effect without any visible movements in the ossicles.

In 1860 Politzer⁴ showed that the tensor tympani was supplied by a branch of the motor division of the fifth nerve.

¹ Gray.

² Ueber die Arteria Stapedia des Menschen, Monatsschr. f. O., No. 1, 1873.

³ Henle, op. cit., p. 748.

⁴ Meissner's Jahresbericht, S. 583.

Later, Voltolini¹ performed a series of experiments with electricity on the trigeminus. He showed that the tensor tympani can be put into motion by excitation of these two cerebral nerves, and he used this fact as an explanation of the power the muscle has of both voluntary and involuntary movement. Then arises, as Voltolini suggests, the important question whether the fibre from the facial nerve, supplying the tensor, also passes through the otic ganglion, or goes directly from the facial to the muscle; in the latter case the muscle would evidently possess power of voluntary motion. Although no one has demonstrated that a branch of the facial nerve does pass directly to the tensor tympani, the muscle certainly possesses power of voluntary contraction, as held by Johannes Müller, Voltolini, and others.

In this connection it must not be forgotten that the tensor tympani muscle is closely related to the muscular structures of the Eustachian tube. The latter obtains innervation from the glossopharyngeal nerve, and by this means also the tensor tympani muscle may obtain some of its nerve-supply from this sensori-motor nerve.

Physiological Nature of Certain Tympanic Bands, heretofore considered Pathological.—Urbantschitsch² has pointed out the physiological nature of certain membranous and cord-like adhesions in the cavity of the tympanum, which have heretofore been considered pathological.

Function of the Round Window and its Membrane.—In 1871 I made some investigations into the condition of the membrana secundaria, or the membrane of the round window, during the movements of the ossicles of hearing, and the excursions performed by it were measured under the microscope. During these investigations I also noticed the effect of varying labyrinthine pressure upon the small bones of hearing and the membrane of the round window. All the observations were made upon temporal bones from human subjects as soon as possible after death. During these observations one preparation was found that did not respond to the notes of the organ-pipes as the previous ones had done. The ossicula auditus manifested some very slight vibratory motions, but the membrane of the round window showed none. In order to explain this apparently abnormal result, and to find out whether an increased or diminished labyrinthine pressure could have produced it, the following experiments were instituted:

Upon a perfect petrous bone, which failed to respond to the sounds produced by the already mentioned organ-pipes, the superior semicircular canal was opened at its summit, and to this opening one end of a small glass tube, one centimetre long by five millimetres wide, was hermetically sealed. The bone thus modified was placed in water and brought under

¹ Virchow's Archiv, Bd. lxx. S. 467.

² Beiträge zur Entwicklungsgeschichte der Paukenhöhle. Report of Royal Academy of Sciences, Vienna, January, 1873.

the air-pump, in order to remove any air which might have entered the labyrinth. After these arrangements the glass tube, sealed to the superior semicircular canal, was connected by a gutta-percha tube, of similar diameter, to a reservoir of water, consisting of a funnel placed in a retort-holder, and which could be elevated or depressed at will. The pressure exercised by the water upon the labyrinth could easily be seen with the unaided eye, as the varying height of the funnel caused the column of water to press with greater or less force upon the membrane of the round window.

With these modifications, the preparation, which formerly failed to respond to the notes of the organ-pipes, was placed in connection with the sources of sound, and the chain of bones, as well as the membrane of the round window, was observed during the passage of a note to the ear.

The desired excursions now became apparent upon the hitherto abnormal specimen, and resembled those upon other preparations, so long as the pressure was maintained at a certain grade; but when increased or diminished beyond a given point, the excursions upon the ossicles and the membrane of the round window ceased. *This cessation was observed to take place sooner during the occurrence of high than of low and powerful notes.*

The human ear, in the living state, sometimes fails to perceive high notes, while lower ones are distinctly heard. Perhaps such phenomena may be explained by an application of the results obtained in these investigations, in which artificial labyrinthine pressure interfered with the action of the chain of ossicles and the membrane of the round window sooner in connection with high notes than with lower ones.

In cases of hemorrhagic or serous effusions into the internal ear it may be supposed that the accumulation of pathological fluids in the labyrinth interferes with the action of the chain of bones and the membrane of the round window, just as the artificial pressure did in my experiments.

In addition to these destructive changes, which follow pathological processes in the ear, the perilymph of the labyrinth may be subject to great fluctuations in its amount, since the arachnoid sac and the labyrinth are intimately connected, as experiments of Weber-Liel¹ and Hasse² show.

The following deductions may be drawn from the author's experiments:

1. The excursions of the chain of ossicles of hearing bear a fixed relation to one another.
2. The excursions of the ossicles of hearing are communicated through the labyrinthine fluid to the membrane of the round window.

¹ M. f. O., August, 1870.

² Anatomische Studien, No. 19, S. 768.

3. The excursion of the membrane of the round window generally equals that of the stapes; but it may equal that of the membrana tympani, at the lower end of the manubrium mallei.

4. The pressure within the labyrinth, increased beyond certain limits, causes cessation of the action of the membrane of the round window and the chain of ossicles of hearing. This occurs sooner in connection with high notes than with the lower notes of the scale.

5. If the labyrinthine pressure is greatly diminished or totally removed, the chain of ossicles may continue to vibrate, but they exert no influence upon the membrane of the round window.

6. The vibrations of the membrane of the round window vary from $\frac{1}{1000}$ to $\frac{1}{10000}$ of a millimetre.¹

A difference of opinion has existed respecting the part the membrane of the round window plays in the conduction of sound. Without doubt the excursions of the ossicles of hearing are conveyed through the water of the labyrinth to the membrane of the round window, as shown by the experiments of A. H. Buck and of the author, and later by the corroborative experiments of Weber-Liel.

The Power of Muscular Accommodation.—According to Lucae's experiments,² the ear has, in the tensor tympani and stapedius muscles, an apparatus for accommodating itself to various sounds. The first muscle aids in the accommodation for low musical tones, the latter accomplishes the same for high unmusical sounds.

Abnormal contraction of the tensor tympani, with insufficient antagonism of the stapedius, produces a modification of perception, termed by Lucae "low hearing;" an analogous condition of the stapedius muscle in its relation to the tensor tympani produces "high hearing."

¹ All the measurements I obtained may be found recorded in the Archives of Oph. and Otol., 1872.

² Die Accommodation und Accommodationsstörungen des Ohres. A. Lucae, Berliner Klin. Wochenschrift, 1874, No. 14. Abstract by Jacoby, Archiv f. O., Bd. ix. ss. 184, 185.

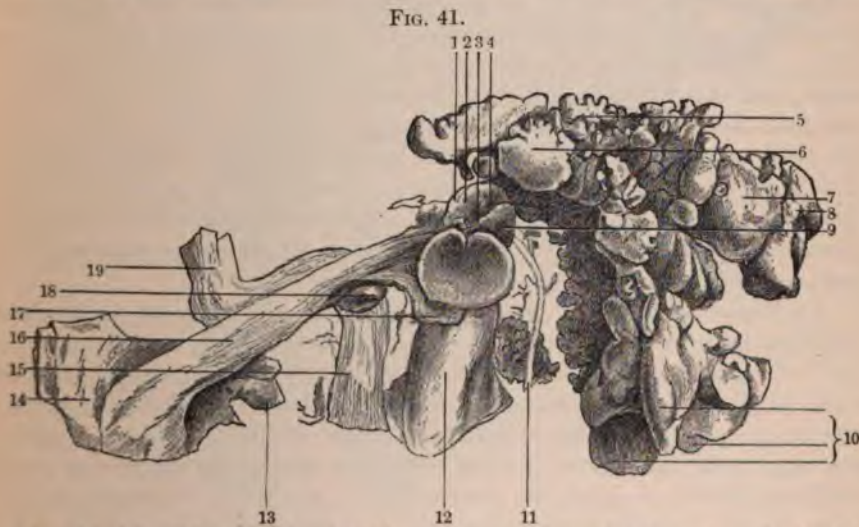
CHAPTER V.

THE ANATOMY AND PHYSIOLOGY OF THE EUSTACHIAN TUBE AND MASTOID.

ANATOMY.

THE Eustachian tube, though discovered by Vesalius, gets its name from Bartolommeus Eustachius,¹ who gave a more complete description of it than any of his contemporaries or predecessors. Though it is generally conceded that Vesalius was the discoverer of the tube, some authorities think that even Alcmeon² and Aristotle³ knew of its existence.

The Eustachian tube is the only means of aërial communication between the pharynx and middle ear. It opens into the pharynx a little



Cast of the left middle-ear cavities, viewed from without. (Siebenmann.) 1, superior malleo-incudal fold; 2, upper malleo-incudal space; 3, Prussak's space, superior pouch; 4, exterior malleo-incudal fold; 5, 6, exterior superior cells of the squama; 7, 8, posterior superior horizontal cells of the mastoid; 9, inferior malleo-incudal space; 10, cells of the mastoid process; 11, facial nerve; 12, jugular bulb; 13, Rosenmüller's fossa; 14, wall of the pharynx; 15, carotid artery, with carotid sinus in white; 16, Eustachian tube; 17, floor of the drum-cavity; 18, tubal cells; 19, internal carotid artery.

above the floor of the nose, and passes backward, upward, and outward to the cavity of the tympanum, forming an angle of forty degrees with the horizon and one hundred and thirty-five degrees with the axis of the external auditory canal. The pharyngeal mouth of the tube is wide, but

¹ 1500-1574.

² 570 B.C.

³ 384-322 B.C.

the tube narrows rapidly to the *isthmus*, from which point it widens again to the tympanic cavity. It therefore resembles, somewhat, two short and wide-based cones, placed point to point, their junction marking the position of the isthmus. The pharyngeal mouth of the tube is oval in shape, being nine millimetres high and five millimetres wide. At the isthmus, the junction of the osseous with the cartilaginous part of the tube, the diameter is from one and one-half to two millimetres, and the greatest diameters of the osseous canal vary from four to four and one-half millimetres. The entire length of the Eustachian tube is thirty-five millimetres, one and three-eighths inches, the bony portion being eleven millimetres and the cartilaginous part twenty-four millimetres long (Fig. 41).

Bony Portion of the Eustachian Tube.—As already stated, the Eustachian tube is composed of a bony and a cartilaginous portion. The former lies entirely within the petrous bone;¹ the latter portion is joined to the former and is about two-thirds of the entire tube. The caliber of the bony portion is triangular; the angles, however, are rounded by the mucous lining of the tube. Its average diameter is about two millimetres. The outer wall of the three composing this triangular bony tube belongs to the pars tympanica, the inner wall separates the tube from the carotid canal, and the upper wall is formed internally by the septum tubæ and the floor of the canal for the tensor tympani, and outwardly it unites with the outer wall of the bony tube in the petrotympanic or Glaserian fissure. The posterior wall of the bony portion of the canal is somewhat longer than the anterior wall. Usually the bony Eustachian tube is twice as wide as the semi-canal of the tensor tympani, but in some instances these relations are reversed, as shown by Rüdinger.

Cartilaginous Portion of the Eustachian Tube.—In order to understand the true form of this part of the Eustachian tube one must imagine a shell of cartilage, not quite an inch long, bent so that a section of it at right angles to its long diameter resembles a hook or shepherd's crook. The longer portion of this section of cartilage will represent a section of the inner wall, the shorter portion represents that of the anterior or outer wall, and the curve shows the position of the roof of the Eustachian tube (Fig. 42, 8). It will be seen, therefore, that this part of the tube is not a complete and round cartilaginous canal, but rather a flattened tube, the posterior wall and roof of which are made entirely of cartilage, while the anterior wall is of cartilage only in its upper part, its lower portion being *muscular*² and completing the tube. The upper part of the inner cartilagi-

¹ In some cases the large wing of the sphenoid bone unites in the formation of the osseous part of the Eustachian tube, or at least it forms, with the pars petrosa, the sulcus petrosphenoidalis for the reception of the cartilage of the tube. (Rüdinger, *Die Ohrtrompete*, S. 2.)

² Formerly this part of the canal was called membranous, but, since muscular tissue is so intimately concerned in its formation, Rüdinger proposes to call it muscular, as being more truly descriptive.

nous wall, as well as the roof of the tube, is fastened to the base of the skull by means of the basilar fibro-cartilage (Fig. 42, 9). The lower end of the inner wall is movable. That part of the cartilage of the Eustachian tube which curves forward to form the upper part of the outer or anterior wall of the tube is widest and most movable in its middle portion; it is narrower and more firmly fixed at its two extremities,—viz.,

FIG. 42.



Transverse section through the middle of the Eustachian tube, slightly magnified. (Siebenmann.) 1, larger superficial petrosal nerve; 2, carotid artery surrounded by carotid sinus; 3, venous plexus; 4, mucous glands of the inner tubal wall; 5, mucous glands of the outer tubal wall; 6, tongue-shaped projection of the lower edge of the inner tubal cartilage; 7, levator veli muscle; 8, fat embedded in the fibrous mass fixing the cartilaginous tubal hook to the base of the skull; 9, basilar fibro-cartilage.

above, where it is joined to the jagged bony edge of the osseous canal, and below, to the pterygoid process.

The caliber of the tube, in the main, is not round, but cleft-like, and slightly sigmoid in shape; however, that portion of the caliber lying in the curve formed by the cartilage as it turns forward—*i.e.*, that part lying entirely within cartilaginous boundaries—is round and more open than the rest of the lumen of the tube, owing, probably, to the stiffness of the cartilage (Fig. 42, 4 and 5). This fact will always insure at least

a portion of the tube's being more likely to be free from obstructions or from having its two sides stick together. To this more patulous part Rüdinger has given the name of safety-tube (Sicherheitsröhre), and to the cleft-like caliber of the tube below this rounder lumen he has given the name of "accessory cleft" (Hilfsspalte), "since, according to Du Bois Raymond, these terms express most clearly their physiological importance."¹ The posterior cartilaginous wall of the Eustachian tube projects well into the pharynx, forming there a prominent ridge, the anterior boundary of the fossa of Rosenmüller. Into the latter the Eustachian catheter is often placed in mistake for the pharyngeal mouth of the Eustachian tube. When the latter is to be catheterized, this prominent ridge, marking the termination of the cartilage of the Eustachian tube, should be sought for and thoroughly located with the beak of the catheter. In order to do this it is well to allow the catheter to pass first into the fossa of Rosenmüller, then to glide gently forward over the aforesaid cartilaginous lip, by which act the beak can hardly escape going into the pharyngeal mouth of the tube.

As already stated, the cartilaginous shell of the Eustachian tube is adherent at its curve or roof to the base of the skull by means of the basilar fibro-cartilage; the edges of the shell—*i.e.*, the edges of the anterior and posterior lips of the cartilage of the tube—are free, and from them important muscular structures arise. The inner dilator of the tube, or the *salpingo-pharyngeus* muscle, is one of these, and arises from the edge of the posterior cartilaginous wall of the Eustachian tube, and passes towards the superior constrictor of the pharynx. There is also an intimate topographical² relation between this inner wall and the inner surface of the levator palati (petrostaphylinus, Henle), which muscle, in conjunction with the salpingo-pharyngeus, the inner dilator of the tube, brings about movements of the cartilage (Fig. 43, c).

Tensor Palati Muscle.—The most important of all the muscles of the Eustachian tube is the tensor palati³ (Fig. 43, a). This muscle arises by a flat tendon from the posterior edge of the hard palate, in intimate connection with the tendon of its fellow of the opposite side, and, gradually narrowing into the tendon which passes around the pterygoid hook, spreads out again from this point into a fan-shaped muscular layer, the free, broad edge of which is inserted into almost the entire length of the anterior lip of the cartilage of the Eustachian tube (Fig. 43, a).

By the contractions of this muscle the anterior wall of the cartilage of the tube is pulled outward and downward, and thereby the caliber of the canal is widened.

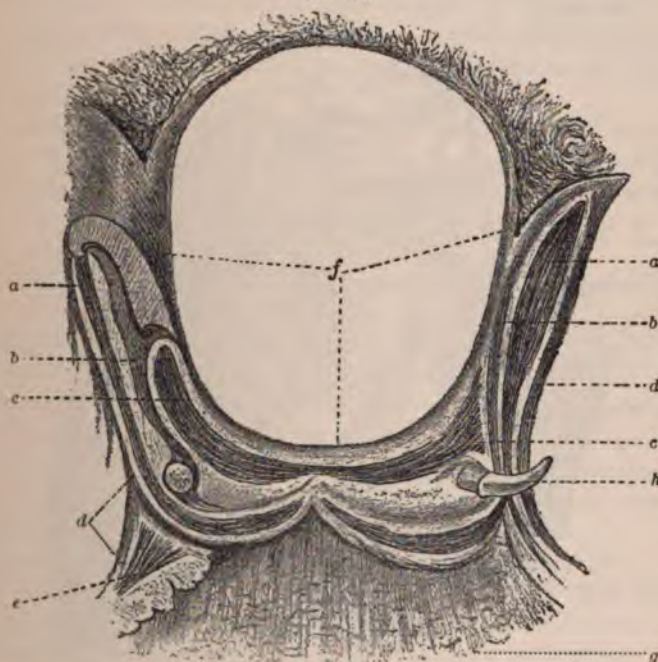
¹ Rüdinger, *Ohrtrompete*, S. 7.

² This muscle sends a few fibres to the posterior cartilaginous wall of the Eustachian tube near the junction of the cartilage with the bony portion of the tube.

³ This muscle has received various names: tensor veli; tensor veli palatini; dilator tubæ (Rüdinger); spheno-salpingo-staphylinus, etc.

According to the investigations of Rüdinger,¹ there is a direct connection between the tensor palati (dilatator tubæ) and the tensor tympani muscle. Not only do the tendinous fibres, but also the muscular fibres of the one pass over into those of the other at the upper part of the Eustachian tube. This connection is of the greatest importance when considering the cause and treatment of certain forms of hardness of hearing due to muscular weakness in the tensor veli.

FIG. 43.



Diagrammatic section through the Eustachian tube, the muscles and fasciæ. (On the left side, the section is supposed to be a vertical one passing through the tube; on the right side, it is supposed to pass under the floor of the tube.) (Weber-Liel.) *a*, tensor veli muscle; *b*, fascia salpingo-ptyergo-staphylina; *c*, levator palati muscle; *d*, fascia pharyngea externa, passing into the tubal fascia above; *e*, buccinator muscle; *g*, hard palate; *h*, pterygoid hook; *f*, fascia pharyngea interna.

It is now generally conceded, through the labors of Rüdinger and others, that there is a small part of the normal Eustachian tube, the so-called safety-tube, in its upper part, under the cartilaginous hook, always wide enough open to allow a recoil of air to occur from the drum-cavity if the drum-head is suddenly driven in, as in explosions, and also to permit a slow equalization of pressure in the tympanic cavity, from the pharynx, independently of the act of swallowing. But this safety-canal is not wide enough to allow constant ventilation of the drum-cavity to go

¹ Op. cit., p. 6.

on. Therefore, to insure ventilation of the tympanum, the normal tube is opened at every act of swallowing.

The Inner Pterygoid Muscle.—This muscle is considered by Weber-Liel as specially belonging to the muscles of the Eustachian tube.¹ According to his observations, some of the upper, shorter, and hinder fibres of this muscle are inserted into the fascia of the floor of the tube throughout its length, and are then lost in the fibrous covering of the petrous bone. Its function is that of a tensor of the fascia of the Eustachian tube.

FIG. 44.



Transverse section through the Eustachian tube at its lower end; slightly magnified. (Siebenmann.) 1, spongy bone of the skull base; 2, mucous glands and adipose tissue of a tangential section through the mucous membrane of Rosenmüller's fossa; 3, tubal cartilage; 4, mucous membrane of the lateral portion of the pharynx opened by the above-named section; 5, retrahens muscle of the tube; 6, levator veli muscle; 7, mucous glands of the floor of the Eustachian tube; 8, lumen of the tube; 9, mucous membrane of the outer wall of the Eustachian tube; 10, tensor veli muscle; 11, mucous glands of the inner wall of the Eustachian tube; 12, internal pterygoid muscle.

Mucous Membrane of the Eustachian Tube.—The mucous membrane of the Eustachian tube is a continuation of that of the pharynx. It is supplied with ciliated epithelium, the cilia of which move in a direction from the tympanic cavity towards the pharynx, thereby favoring the passage of fluids from the cavity of the drum and tube into the throat.

The Eustachian tube is very rich in glands at certain places; although the upper concave portion of the cartilaginous roof of the canal is en-

¹ Progressive Schwerhörigkeit, Berlin, 1870, Ss. 68-71.

tirely free from glands, the sides of the tube, in the pharyngeal portion, are richly supplied with acinous mucous glands, emptying into the folds of mucous membrane, as shown by Rüdinger. These mucous glands do not differ from those of the œsophagus and pharynx. In the upper portions of the tube, towards the tympanic cavity, all glands become sparse.

In addition to the glands just named, Gerlach¹ has shown that the mucous lining of the cartilaginous portion of the tube is richly supplied with follicular glands, which are most numerous at its middle part. Placed still deeper in the submucous connective tissue are numerous acinous glands. The follicles of the tubal mucous membrane are about half as large as those of the pharynx, but take in the entire depth of the mucous membrane.

Tonsilla Pharyngea.—According to the investigations of Santorini and Luschka, it is shown that the lining structures of the roof, and to a great extent the hinder wall of the nasal part of the pharynx, are composed of a tissue so strikingly like the substance of the tonsils that it has been named the “pharyngeal tonsil.”

Luschka states that this spongy tonsillar substance, of a maximum thickness of seven millimetres, which he has never failed to find, extends from the posterior boundary of the roof of the nasal cavity to the edge of the foramen magnum of the occipital bone, where it assumes a more or less uneven surface, or, breaking up into separate sebaceous glands, is gradually lost in the posterior wall of the pharynx. The same kind of structure forms the chief constituent of the recessus pharyngeus, and extends in a thinner layer over the ridge of the pharyngeal mouth of the Eustachian tube.

Differences in Size and Shape of Mouth of Eustachian Tube.—Urbantschitsch² has described great variations in the shape and size of the pharyngeal mouth of the Eustachian tube. These variations occur not only in those of the same age, but also in the same individual.

Blood-vessels and Nerves of the Eustachian Tube.—The arteries supplying the Eustachian tube are the *pharyngeal* from the external carotid, the *middle meningeal branch* of the internal maxillary, and various small branches of the *internal carotid*.

The nerves are distributed as follows. The tensor palati, or the dilator tubæ muscle, is supplied by a branch from the otic ganglion, and also by a motor branch from the internal pterygoid nerve, a muscular branch of the smaller division of the inferior maxillary nerve. The levator palati muscle is supplied by the facial nerve through its connection with the Vidian and petrosal nerves, as well as by a branch from the vagus.

¹ Zur Morphologie der Tuba Eustachii. Sitzungsberichte d. Erlanger Physicalisch-Med. Soc. Abstract by von Troeltsch, A. f. O., 1875, Bd. x. S. 53.

² Anatomische Bemerkungen über die Gestalt und Lage des Ostium pharyngeum tubæ beim Menschen. A. f. O., 1875, Bd. x. Ss. 1-7.

The inner dilator of the tube, the salpingo-pharyngeus, is supplied by the glossopharyngeal nerve. The inner pterygoid muscle is supplied by the inferior maxillary nerve. The mucous membrane of the tube is supplied by branches of the glossopharyngeal nerve, which also supplies the mucous membrane of the tympanic cavity.

The Mastoid Portion of the Temporal Bone and its Cells.—The mastoid portion is that highly important part of the middle ear situate behind and partly below the cavity of the tympanum. It corresponds to the protuberance behind the auricle. This hollow portion is developed partly from the squamous portion, but chiefly from the petrous part of the temporal bone. As is well known, the temporal bone is formed from three distinct pieces, the squama, the annulus tympanicus, and the

petrous pyramid. The squama is divided into two parts,—viz., the vertical and the horizontal portions. The horizontal portion is subdivided into an inner and an outer lamella, the latter of which forms part of the air-cavities of the mastoid portion. This portion of the temporal bone has a distinct existence by the fifth fœtal month. The mastoid portion is really a continuation of the petrous part of the temporal bone backward and downward.

The *upper surface* of the mastoid portion unites with the postero-external edge of the roof of the tympanum. This is marked by a furrow until immediately after birth, when it usually becomes invisible.

In a child a few months old the *outer surface* shows a deficiency at its upper and anterior edge,—the so-called mastoid-squamous fissure. Sometimes, at this early age, the fissure is not at all marked, its place being represented by a series of irregular openings varying from two to three millimetres in diameter, as though union between the squama and the

outer mastoid wall was already far advanced.

The *inner surface* is quite concave, and over it runs a furrow, which at last is fully developed into the sigmoid sinus.

The *mastoid foramina* are found near that point where the upper and under edges of the mastoid portion meet. In some cases the foramina are not complete until the occipital bone joins the mastoid edges. These openings are for the passage of arteries to the dura mater, and for small veins which connect the transverse or lateral sinus with the veins of the scalp.

Mastoid Cells.—Within the mastoid portion are found the mastoid cells. These are a series of bony air-chambers of variable size, communicating

FIG. 45.



Mastoid cells, left side, viewed from behind. (C. J. Blake.)

with one another by means of foramina in their thin walls. They communicate with the tympanic cavity by means of the mastoid antrum and aditus, and are lined by a continuation of the same mucous membrane lining the Eustachian tube and tympanic cavity. The number and development of these cells vary, not only in different individuals, but in the same individual, on the two sides. It is of the highest importance to understand their general distribution in the adult bone, in order to diagnose and treat inflammatory processes arising there, or which have spread to that part from the tympanic cavity.

In the mastoid portion of the child it is found that the septum dividing the mastoid cavity from the sigmoid sinus is very thick, and hence inflammation is not likely to pass from the former to the latter, as it is in adults, in whom this septum is always thin. Hence, in very young children, meningitis very rarely, if ever, occurs from inflammation of the mastoid cavity, from which inflammation tends to pass outward rather than inward, not only because the dividing septum between it and the sigmoid sinus is thick, but because, as already stated, the outer wall of the mastoid portion is imperfect in early childhood. This is the reverse of what we find in the adult, so that in the latter everything favors a passage of disease of the mastoid cells inward towards the brain, while in the child the conditions are in favor of a passage outward of disease in this region.

The lower pointed part of the mastoid portion is known as the *mastoid process* (Fig. 41, 10; Fig. 47, 18); to it the sterno-cleido-mastoid muscle is attached. The development of the mastoid process is greater in the strong and muscular, while it is less developed in the weak and in children. The mastoid portion is also subject to differences in development in different races, being small and solid in negroes, while in Mongolians it is found much more highly developed than in Caucasians, as shown by Welker.

In the first year after birth the mastoid cavity loses its pyramidal shape by assuming a more ovoid form, and the mastoid cells are formed gradually. Those which are included in the upper and outer portion of the mastoid where it joins the squama are the most highly developed at this time, and lined with mucous membrane, while the mastoid process as yet

FIG. 46.

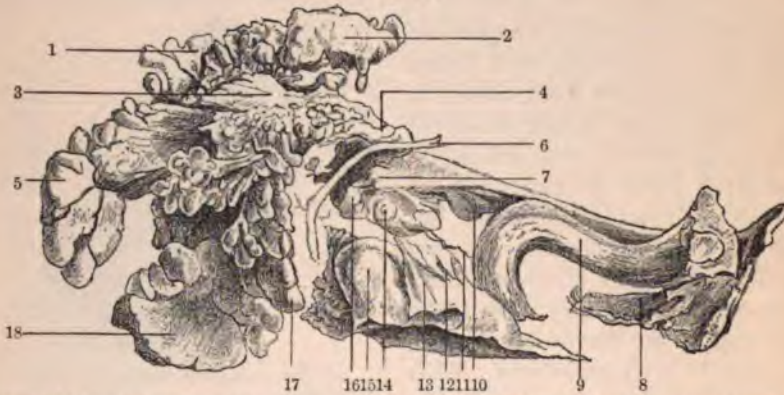


Auditory apparatus, left side, viewed from above, after removal of the tegmen tympani and upper half of the labyrinth; natural size, from photograph. 1, internal auditory canal; 2, auditory nerve; 3, modiolus of cochlea; 4, vestibule and horizontal semicircular canal; 5, membrana tympani, inner surface; 6, annulus tympanicus; 7, malleo-incudal joint; 8, aditus ad antrum; 9, antrum; 10, mastoid cells; 11, middle cranial fossa, back part.

contains no air-cells. From this time on the external differences of this part of the temporal bone are much less than the differences in development of the air-cells within, for the latter are subject to the greatest variations in number and distribution, as can readily be seen in the skulls of adults.

The so-called *mastoid antrum* is really part of the tympanic cavity, and is of a triangular shape (Fig. 34, *h*). Its position is somewhat above, in front of, and farther inward than the rest of the mastoid cells. Its walls, with the exception of part of its outer wall, are formed by the petrous part of the temporal bone, and communicate by numerous perforations with the mastoid cells, by which it is surrounded on

FIG. 47.



Cast of the left middle ear; view of inner surface of the cast shown in Fig. 41. (Siebenmann.) 1, outer upper horizontal cell of the squama; 2, anterior upper horizontal cell of the squama; 3, tegmen antri; 4, superior malleo-incudal fold; 5, posterior upper horizontal cell of the squama; 6, facial nerve; 7, oval window with the crura of the stapes; 8, wall of the fauces; 9, internal carotid, with its sinus in white; 10, tympanic cell; 11, carotico-tympanic canals; 12, vascular canals between the jugular bulb and the drum-cavity; 13, aqueductus cochleæ; 14, round window; 15, jugular bulb; 16, posterior tympanic sinus; 17, small inner mastoid cells; 18, large inner cell of the mastoid process placed directly under the transverse sinus.

all sides excepting in front and on the inner side. Anteriorly it has a wide opening into the tympanic cavity, the aditus (Fig. 46, 8, 9), and on its inner side it is bounded by that part of the petrous bone covering in the horizontal semicircular canal. The air-containing cavities fill the entire mastoid portion of the temporal bone, and in most cases they spread downward and outward to the very point of the mastoid process.

Limits of the Mastoid Cells.—The mastoid cells extend as far backward as the emissarium mastoideum, where they are in close contact with the outer side of the groove for the sigmoid sinus, and they are found as far forward as the external auditory canal. Mastoid cells are also found continuous with those which reach as far forward and upward as the petrosquamous suture, above the point where the outer table of the

mastoid portion is nearest the inner table,—that is, the outer wall of the sigmoid groove (Fig. 41, 5–10, and Fig. 47, 1–3, 5–18).

The lowest limit of the mastoid cells is the tip of the mastoid process. Those cells which are developed from the petrous part of the bone are the largest; those which arise from the squama and lie over the external auditory canal are the smallest.

Conjoint Physiology of the Eustachian Tube, Tympanic Cavity, and Mastoid Cells.—According to the carefully conducted experiments of Mach and Kessel¹ on the functions of the tympanic cavity and the Eustachian tube, it is shown that sound-waves will produce the greatest effect when, in the middle ear, the following three conditions are maintained:

1. The Eustachian tube must, as a rule, remain closed.
2. It must, however, be opened occasionally for purposes of ventilation.
3. The tympanum should be in connection with large, irregular cavities.

¹ Die Function der Trommelhöhle und der Tuba Eustachii. Sitzungsberichte der k. k. Academie d. Wissensch., 1872. See also Archiv f. Ohrenh., N. F., Bd. ii. Ss. 116–121.

the perilymph. This perilymphatic space communicates with the vestibule, and places the vestibular and tympanic scalæ of the cochlea in the perilymphatic system of the labyrinth, while the cochlear duct, or the scala media of the cochlea, contains endolymph, like the sacculi of the vestibule and the membranous semicircular canals, and is therefore part of the endolymphatic system of the labyrinth.

ANATOMY OF THE LABYRINTH AND AUDITORY NERVE.

The internal ear, sometimes called the labyrinth, is composed of a bony portion or case, and a membranous portion contained in the latter.

The bony as well as the membranous portion of the internal ear consists of the vestibule, the central portion, with which the cochlea is connected in front, and the semicircular canals behind.



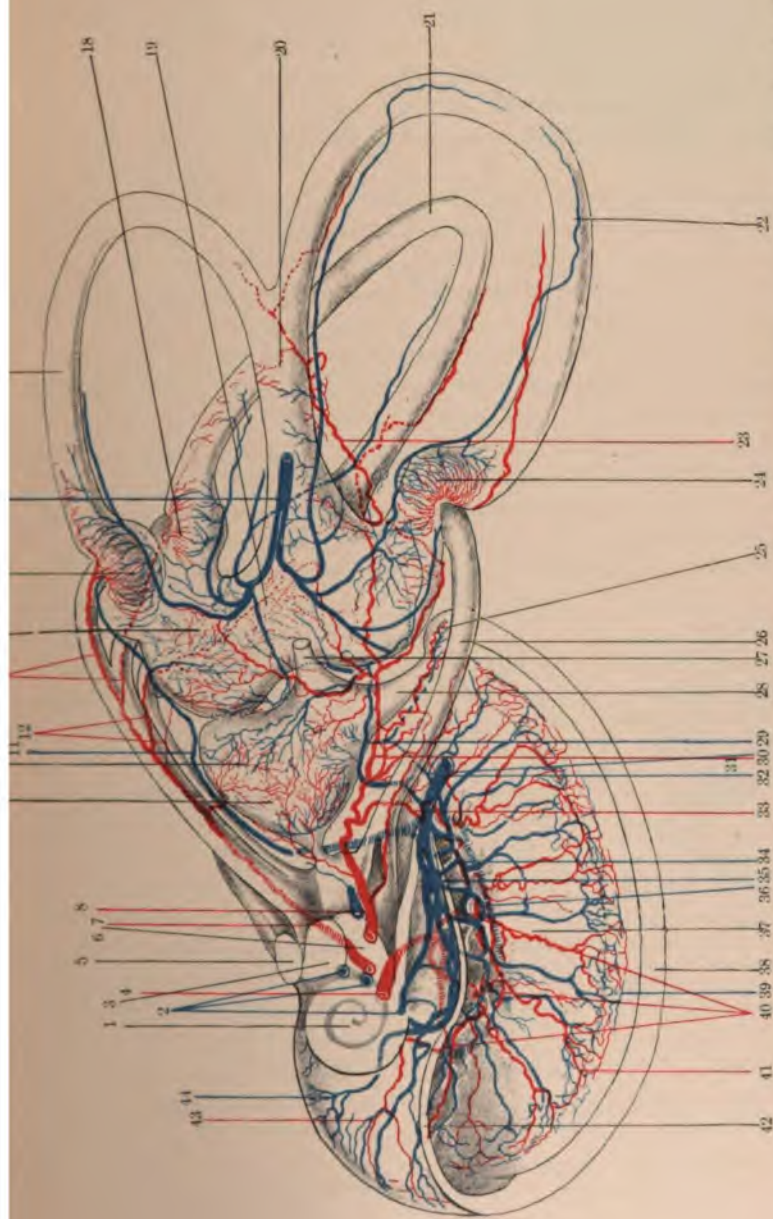
Fig. 48.
External view of a cast of the left labyrinth. (Henle.) *f*, fenestra cochleæ, or round window; *a*, fenestra vestibuli, or oval window; *b*, ampulla of superior semicircular canal; *c*, ampulla of posterior semicircular canal; *d*, common shaft of union of these two canals; *e*, ampulla of the horizontal semicircular canal; *g*, tractus spiralis foraminosus.

The Vestibule.—The vestibule is a small cavity situate just beyond the inner wall of the tympanum. This wall is common to both cavities, and in it is the oval window, into which fits the foot-plate of the small stirrup bone (Fig. 48, *a*). A section of the vestibule parallel to its tympanic wall is round or elliptic, but a section at right angles to this, and running parallel to the floor of the tympanum, is in general of a pear shape, the point of which is directed forward. This, of course, indicates that there is a general tendency on the part of the four walls of the vestibule to unite anteriorly near

the cochlea. This convergence of the vestibular walls is seen in Plate I. The average distance of the outer from the inner wall of the vestibule is from three to four millimetres; its long diameter, running between its anterior and posterior limits, is about five millimetres, as given by Henle.

The Ampullar Mouths of the Semicircular Canals.—On the upper wall of the vestibule, just above the recessus ellipticus, is the ampullar opening of the superior semicircular canal; in the angle between the posterior and inner walls, near the inner opening of the aquæductus vestibuli, is found the ampullar opening of the common end of the superior and posterior semicircular canals. At about the same height in the centre of the posterior wall is the posterior opening of the horizontal semicircular canal. The lower opening of the posterior semicircular canal is in the angle formed by the union of the posterior, the inferior, and the inner walls of the vestibule. The anterior ampullar mouth of the horizontal semicircular canal is in the outer wall between the oval window and the ampulla of the superior semicircular canal (Fig. 48, *e*).

Macule Cribrosæ.—These are groups of fine microscopic openings



Membranous labyrinth of the right side, seen from within, above, and behind. (F. Siebenmann.) 1, cochlear nerve; 2, internal auditive vein; 3, utricle-ampullar nerve; 4, cochlear artery; 5, facial nerve; 6, sacculo-ampullar nerve; 7, anterior vestibular artery; 8, vestibulo-cochlear artery; 9, macula acustica of the saccule; 10, sacculus; 11, anterior vestibular vein; 12, artery of the macula of the utricle; 13, arteries of the ampullar limbs of the superior external canal; 14, macula acustica of the utricle; 15, superior ampulla; 16, vein of the aqueductus vestibuli; 17, superior semicircular canal; 18, external ampulla; 19, utricle; 20, sinus superior; common limb of the superior and the posterior semicircular canals; 21, external (horizontal) semicircular canal; 22, posterior semicircular canal; 23, terminal branch of the posterior vestibular artery; 24, posterior ampulla; 25, cul-de-sac of the vestibule; 26, nerve of the aqueductus vestibuli; 27, aqueductus vestibuli; cut off; 28, canalis reuniens of Hensen; 29, posterior vestibular vein; 30, posterior vestibular artery; 31, vein of the aqueductus cochleae; 32, venous arches of the lamina spiralis; 33, cochlear branch of the vestibulo-cochlear artery; 34, vein of the lamina spiralis; 35, posterior spiral vein; 36, anterior spiral vein; 37, lamina spiralis of the basal whorl; 38, cut surface of the ligamentum spirale; 39, vas spirale; 40, first, second, and third branches of the cochlear artery; 41, arterial arch in the outermost part of the lamina spiralis; 42, cut surface of the under wall of the scala tympani; 43, arteries of the under wall of the scala tympani; 44, veins of the same.

through which the nerves enter the vestibule. The superior group is found at the upper spinous termination of the crista vestibuli, a second group is in the recessus sphaericus, and a third is situate at the ampullar opening of the posterior semicircular canal. Through the superior cribriform spot nervous filaments pass to the utriculus and to the ampullæ of the superior and the horizontal semicircular canals, through the middle cribriform spot nerves pass to the sacculus, and through the lower spot the ampulla of the posterior semicircular canal is supplied (Plate I., 9 and 14).

Reichert has described a fourth cribriform spot, in the upper part of the recessus cochlearis, near the origin of the lamina spiralis. This gives admission to a filament from the smaller branch of the cochlear nerve, which is distributed to the septum between the sacculi in the vestibule.¹

The Cochlea.—The bony cochlea may be described very briefly as an osseous canal twisted spirally two and a half times about a bony pillar. This shape closely resembles that of a snail-shell, and has suggested the name of the cochlea. The bony cochlea may be divided into the spiral canal, modiolus, and the lamina spiralis ossea, which, projecting from the modiolus into the caliber of the canal of the cochlea, terminates above at the helicotrema in what is named the hamulus.

The Canal of the Cochlea.—The cochlear canal starts at the extreme outer and lower corner of the vestibule and, winding outward and forward, makes in its first half-turn the promontory of the inner wall of the tympanum.

Each turn of the cochlea is shorter than the previous one, and rising above and beyond it outwardly forms the peculiar resemblance indicated by its name. The height of the cochlea is equal to the diameter of its base, and measures about four or five millimetres. The entire length of the cochlear canal is from twenty-eight to thirty millimetres.

The *modiolus* (Fig. 49, *b*), which may be regarded as representing the axis of the cochlea, is nearly in the axis of the porus acusticus internus and about at right angles to the long diameter of the pyramid of the petrous bone. The point of the cochlea is directed outward, forward, and downward. The latter part of the cochlea, the cupola, is separated by a thin plate of bone from the canal of the tensor tympani muscle, while in front the coils are very close to the carotid canal. The diameter of the canal of the cochlea is about one millimetre at its widest part; from the beginning of the last half-turn it becomes much smaller. A transverse section of the cochlear

FIG. 49.



Section through the osseous capsule and the modiolus of the cochlea, with the lamina spiralis ossea. (Politzer.) *a*, internal auditory canal; *b*, modiolus.

¹ Henle, op. cit., p. 760.

canal varies in shape, being sometimes elliptical and at other times semi-circular. Its more common shape is that of a segment of a circle, the point of which is directed towards the axis of the cochlea. The thickness of the dividing wall between the turns of the cochlea is three-tenths of a millimetre at the lower turn and three-hundredths of a millimetre at the upper part of the canal.

The Modiolus and Lamina Spiralis Ossea.—The general shape of the modiolus is pyramidal. At its base the diameter is two millimetres, at the apex five-tenths of a millimetre, and its height is two and a half millimetres.

The modiolus is not only the bony axis about which the cochlear canal is twisted, but it is traversed by numerous canals for the transmission of blood-vessels and the branches of the cochlear nerve, which are finally distributed like fringe on a bony shelf running spirally around the modiolus and projecting into the canal of the cochlea (Plate II.). This bony shelf is the lamina spiralis ossea (Plate I., 37).

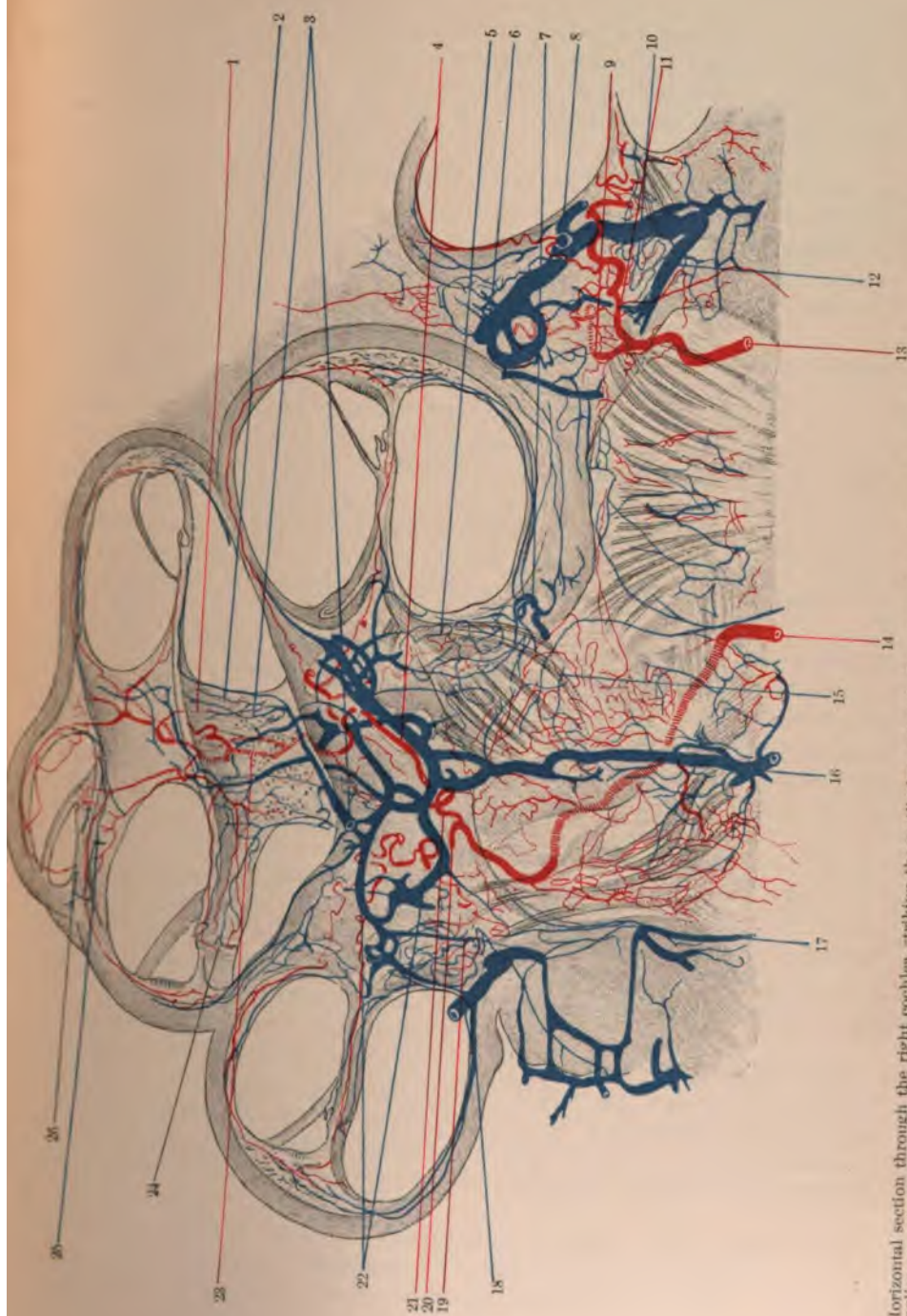
The Scalæ.—The lamina spiralis ossea divides the canal of the cochlea into its scalæ. The upper one of these is the scala vestibuli, beginning at the vestibule and continuing to the helicotrema; the lower one, the scala tympani, may be said to begin at the helicotrema and end at the round window (Fig. 50, *sc v* and *sc t*).

The general relation of the spiral bony lamina to the scalæ, and the relation of the latter to each other, will perhaps be better understood if the reader imagines himself starting from the vestibule along the upper surface of the bony partition between the scalæ, and continuing until he reaches, at the helicotrema, the sharp hook-like end of the bony lamina. At this point he must imagine that what has been the floor of the scala vestibuli now becomes the upper surface or roof of the scala tympani. If the scala tympani be traversed, in imagination, two and a half turns will reach the membrane of the fenestra rotunda.

The lamina spiralis ossea forms only part of the division between the scalæ; as it does not pass as a bony septum from the modiolus to the opposite wall of the canal, the separation of the two scalæ from each other is not complete until the soft parts are added to the osseous structures (Fig. 50, *b*). The lamina spiralis is thicker at its lower end than at the top of the modiolus. At the former point it may amount to three-tenths of a millimetre, but at the upper part to only fifteen-hundredths of a millimetre. The width of the lamina spiralis is one and two-tenths millimetres at the lowest part and five-tenths of a millimetre at the upper part.

The Semicircular Canals.—To the posterior part of the vestibule are attached the three semicircular canals. These are named, according to their positions and planes, the superior, the posterior, and the horizontal semicircular canal (Fig. 48).

Although there are three distinct canals, there are but five openings from them into the vestibule. This is due to the fact that two of the canals, the superior and the posterior, are joined to a common shaft just



Horizontal section through the right cochlea, striking the vestibular end and the cupola, but avoiding the modiolus of the middle whorl. (F. Siebenmann.)
 1, ganglionic artery; 2, ganglionic vein; 3, anterior spiral artery; 4, terminal branch of the cochlear artery; 5, spiral ganglion; 6, anterior spiral vein; 7, posterior spiral artery; 8, anastomosis of the vestibulo-cochlear artery; 9, cochlear branch; 10, central cochlear artery; 11, vestibular branch of the vestibulo-cochlear artery; 12, posterior spiral vein; 13, vestibulo-cochlear artery; 14, vein of the internal porus acusticus; 15, posterior spiral vein; 16, middle cochlear artery; 17, terminal branch of the cochlear artery; 18, vestibular branch of the vestibulo-cochlear artery; 19, central cochlear vein; 20, posterior spiral artery; 21, terminal branch of the vestibulo-cochlear artery; 22, vestibular branch of the vestibulo-cochlear artery; 23, central cochlear artery; 24, vestibular branch of the vestibulo-cochlear artery.

before they reach the vestibule (Fig. 48, *d*, and Plate I., 17, 21, and 22). The position of these openings on the wall of the vestibule has been described already. At one end, each of the canals has a dilated portion, its ampullar enlargement. These enlargements contain soft parts of similar name and shape, the ampullæ of the membranous semicircular canals (Plate I., 15, 18, and 24).

Dimensions of the Semicircular Canals.—The length of the posterior semicircular canal is the greatest of the three, amounting to twenty-two millimetres. The length of the superior canal is twenty millimetres, and that of the horizontal canal is only fifteen millimetres, as shown by Huschke and Henle. The common shaft of the superior and posterior canals is from two to three millimetres long.

A transverse section of these canals is elliptical. The long diameter is to the shorter as 2 : 3 or 3 : 4. The longer measures, in man, from one and three-tenths to one and seven-tenths millimetres. (Henle.)

Ampullar Enlargement.—The shape of the ampullæ is that of an ellipsoid. The ampulla of the superior and of the posterior canal is sharply defined from the rest of the canal, as well as from the vestibule, by a ridge, but the horizontal semicircular canal glides gradually into its ampullar end. The height of the ampulla, in the centre, is about two and one-half millimetres, not quite as great as the longer diameter of its caliber.

The Planes of the Semicircular Canals.—The superior and posterior canals are in vertical planes at right angles to each other. The horizontal semicircular canal, as its name shows, is in a plane at right angles to that of each of the others. The top of the superior canal points upward, making thus a visible ridge on the anterior surface of the petrous bone. The top of the posterior canal points directly backward, as does that of the horizontal semicircular canal (Fig. 48).

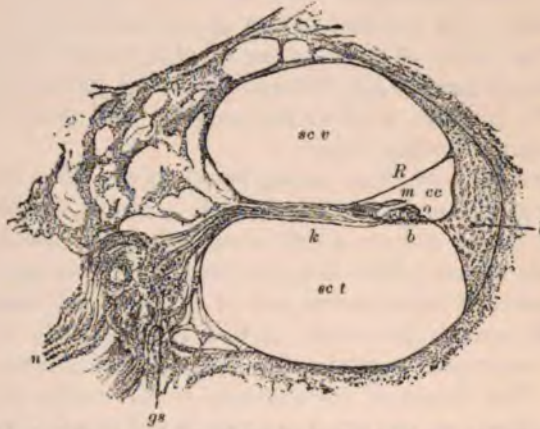
Soft Parts of the Cochlea.—If a transverse section of the canal of the cochlea be examined under the microscope, the manner in which the canal is subdivided into its scalæ will be seen. This division is first indicated by the projection of the lamina spiralis ossea into the caliber of the canal. The free end of this bony shell will, therefore, form a good point for beginning the consideration of the topographical arrangement of the different parts of the cochlea (Plate II.).

Soft Parts of the Lamina Spiralis Ossea.—Upon the upper surface of the lamina spiralis ossea rests the vestibular lamella, and upon the under surface is placed the tympanal lamella of the lamina spiralis ossea. Through the bone lying between these lamellæ runs the nerve on the way to its termination at the organ of Corti and the ciliated cells, a description of which will be given later.

The tympanal lamella is continued in the same plane, directly across from the under edge of the lamina spiralis ossea to the opposite wall of the cochlear canal. Here it is joined to the latter at the thickest point of a

cushion of connective tissue called the ligamentum triangulare (Fig. 50, *l*). The division of one scala from the other is now complete, by the formation of the *membrana basilaris* (Fig. 50, *b*). This membrane does not seem to be very elastic, according to recent observations of Waldeyer.

FIG. 50.



Section through the lower turn of the cochlea of a new-born infant. (Politzer.) *sc v*, scala vestibuli; *sc t*, scala tympanica; *k*, lamina spiralis ossea; *b*, membrana basilaris; *l*, ligamentum triangulare; *R*, membrana Reissneri; *cc*, scala media; *o*, Corti's organ; *m*, Corti's membrane; *n*, fasciculus of the ramus cochleæ; *gs*, ganglion spirale.

The upper or vestibular lamella of the lamina spiralis ossea is the thicker of the two. About half-way between its origin and the point of the spiral bony lamina the vestibular lamina is thickest, from which point it seems to taper to the edge of the bony shelf on which it lies.

At this thick part there rises a delicate membrane, the membrane of Reissner, which springs across the scala vestibuli, and is fastened at a point on the opposite wall of the cochlea about forty degrees above its starting-point. This is a most important membrane, since it forms the upper or vestibular boundary of the ductus cochlearis (Fig. 50, *R*).

The membrane of Reissner is said to consist of a thin connective-tissue basement lamella, rich in vessels. On its vestibular surface large-celled, serous epithelium is found, and on its tympanal surface a single layer of regularly arranged, cubic epithelial cells.

It will now be seen that the cochlear canal is really subdivided into three canals,—the scalæ already named and the ductus cochlearis, or scala media, which is formed at the expense of part of the scala vestibuli (Fig. 50, *cc*). The ductus cochlearis may, therefore, be said to lie upon the membrana basilaris above the grand division-line of the scalæ, and should, indeed, be imagined as slipped into a triangular canal lying between the scalæ at their outer edges. The scalæ are lined with periosteum, covered with large, flat epithelium. They are filled with peri-

lymph, and are in communication with each other only at the helicotrema in the cupola of the cochlea.

The ductus cochlearis is not in communication with them at any point; it begins and terminates in so-called blind ends. The scala tympani ends at the membrane of the round window, but the scala vestibuli is in free communication with the vestibule.

Crista Spiralis.—From the point where the membrane of Reissner is attached to the vestibular lamella of the lamina spiralis ossea there extends a crest or ridge of connective tissue and developed epithelium called the crista spiralis, the serrated edge of which is called by some anatomists “aural teeth.”¹ From this free peculiar edge rises the membrana tectoria, or Corti’s membrane, which extends as far as the beginning of the organ of Corti (Fig. 50, *m*).

The space between the crista spiralis and the point of junction of the lamina spiralis ossea and the membrana basilaris is called the sulcus spiralis internus (Fig. 51, *a*).

Corti’s organ extends from the junction of the membrana basilaris and lamina spiralis ossea to a middle point on the former membrane. From this point the epithelial lining of the ductus cochlearis pursues a less complicated course outward and upward over the wall of the duct (Fig. 50, *o*).

Habenula Perforata and the Zonæ.—The habenula perforata is situated at the extreme thin edge of the osseous spiral lamina, and gives exit to the nerve-branches. The *zona denticulata* extends from the crista spiralis to the outer end of Corti’s organ; the *zona arcuata*, from the inner to the outer ciliated cells; and the *zona pectinata* extends from the outer boundary of the organ of Corti to the spiral ligament of Henle (Fig. 51, *n*). These names are descriptive of the appearance of the region extending from the crista spiralis to the ligamentum spirale, when viewed from above.

The bony portion of the cochlear capsule is divided into a compact inner layer, a tabula vitrea, and the more porous modiolus and lamina spiralis. In the latter is found the canalis ganglionaris, in which lies the spiral ganglion of the auditory nerve (Fig. 50, *gs*). The inner surface of the periosteum of the canal is covered with a layer of simple, large, flat, nucleated cells, similar to those found on the surface of serous membranes.

Ductus Cochlearis.—From the foregoing description of the three divisions of the cochlear canal it must have been seen already that the most important of these is the ductus cochlearis (Fig. 50, *cc*). It is, indeed, from the epithelial lining of this important capsule that the highly organized contents of the cochlea are developed, so as to be the recipients of the terminal filaments of the auditory nerve, after it passes

¹ Gehörzähne of Huschke.

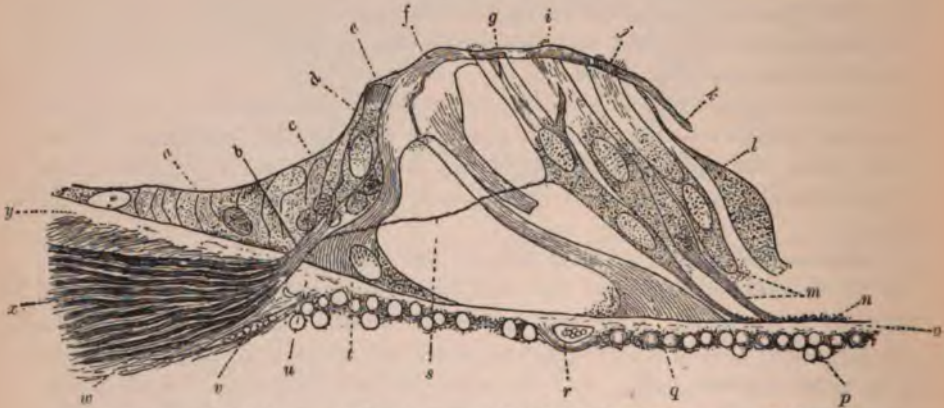
the habenula perforata and reaches the cavity of the ductus cochlearis (Fig. 51, *u* and *b*).

The most important of these structures is the organ of Corti.

The Marquis of Corti¹ was the first to describe this apparatus, and it has from that time justly borne his name. Köl liker and Deiters subsequently enriched the knowledge possessed respecting this important part of the internal ear.

The best treatise on the structure of the cochlea and the distribution in it of the auditory nerve has been written by Professor Waldeyer.² Gottstein, his colaborer, has added the most important facts concerning the ultimate distribution of the auditory nerve to the outer ciliated cells.

FIG. 51.



Transverse section of the organ of Corti; magnified eight hundred diameters. (Waldeyer.) *y, o*, homogeneous layer of the membrana basilaris; *n*, vestibular layer of the same, corresponding to the radii of the zona pectinata; *p*, tympanic layer with nuclei, granular cell-protoplasm, and transversely cut connective-tissue fibrillæ; *y*, labium tympanicum of the crista spiralis; *w*, continuation of the tympanic periosteum of the lamina spiralis ossea; *u*, thickened origin of the membrana basilaris immediately beyond the point of entrance of the auditory nerve *b*; *r*, vas spirale; *v*, blood-vessels; *x*, nerve fasciculus; *a*, epithelium of the sulcus spiralis internus; *d*, inner ciliated cell; *c*, its basilar process: about the latter and above the point of entrance of the nerve are some cells and fine granular matter in which the nerve-fibrils are distributed (granular layer); *e*, inner part of the capital of the inner pillar and the point where the cilia of the inner ciliated cells are situated; *f*, point of junction of the arches; the body of the outer pillar is severed in the middle; behind it appear the body and base of the next pillar at *q*; *l*, base with part of the granular protoplasm of the inner pillar; *g, i, j*, three outer ciliated cells; *m*, basilar part of two other ciliated cells; *l*, Hensen's supporting cell; *f-k*, lamina reticularis; *s*, nerve-fibril distributed to the first ciliated cell, *g*, and traceable through the arch as far as the point of entrance of the auditory nerve at *b*.

Organ of Corti.—The position on the membrana basilaris occupied by the organ of Corti has already been pointed out (Fig. 50, *o*). An idea of the general structure and appearance of this wonderful central portion of the ductus cochlearis can be gained by consulting Fig. 51.

Pillars and Arches of Corti.—Upon the upper or vestibular surface of

¹ Von Siebold and Köl liker's Zeitschr. f. Zoölogie, 1851.

² Stricker's Manual of Physiology.

the membrana basilaris are two sets of pillars, an inner and an outer row, uniting above and forming a series of arches (Fig. 51, *s*). The pillars, like the arches, are named after Corti. They are about three thousand in number, according to Kölliker. A head, head-plate, foot, and body are parts into which anatomists have divided the pillars. At the junction of the pillars, the head of the outer is fitted into a depression between the head and head-plate of the inner pillar (Fig. 51, *f*).

The tunnel thus formed by the arches of Corti is triangular in outline, the longest side of which corresponds to the membrana basilaris. This tunnel extends the entire length of the lamina spiralis almost to the end of the hamulus, as described by Waldeyer. As a rule, the height and width of the arches increase towards the hamulus, as shown by Hensen.

Inner Ciliated Cells.—On the inner side of the arched roof thus formed is found the single row of inner ciliated cells (Fig. 51, *e*). The latter are finally lost at their lower end, in what is termed the "granular layer." Their upper ciliated ends are received into corresponding head-plates of the inner pillars. Their cilia, arranged in dense tufts, are exceedingly stiff and strong.

Outer Ciliated Cells.—The outer ciliated cells are arranged in five parallel rows beyond the row of the external pillars, and underneath the membrana reticularis.

Membrana Reticularis.—The membrana reticularis, as its name indicates, is a net-like structure. It is one of the most complicated parts of Corti's organ, extending from the junction of the pillars to the so-called support-cells at the outermost row of the ciliated cells. Into the meshes of this delicate reticulate membrane fit the tufts of cilia of all the outer ciliated cells. A profile view of this arrangement can be seen in Fig. 51, *f-k*.

Surface of the Membrana Reticularis.—Viewed from above, the membrana reticularis presents not only a very beautiful, but an equally complex appearance. It will be seen that the ciliated cells occupy alternate openings in the mesh of the reticulate membrane in both directions, thus giving a checker-board arrangement to the ciliated tufts and the intermediate spaces when viewed from above (Fig. 51, *i* and *j*).

The constituent elements of Corti's organ have now been described as briefly and in as condensed a way as possible. Of this wonderful organ, Waldeyer says that, if there be left out of this consideration the peculiarities of the inner ciliated cells, the apparently complicated structure of Corti's organ reveals really a simple plan. Several rows of cylinder cells (double cells) are arranged in regular order on a broad zone of the spiral shelf. These rows are parallel to one another, and are held firmly in their position between two membranous boundaries, the membrana reticularis and the membrana basilaris. Two sets of these cylinder cells (the pillar cells) become developed for the purpose of forming a firm arch of support for the whole. Specially worthy of note is the fixation of the outer cili-

ated cells, which, by means of processes and their head-piece, are immovably held between the membrana reticularis and the basilar membrane. These cells, together with the pillars of Corti, exist only in man and other mammals. To this apparatus—*i.e.*, to its peculiar ciliated cells—the terminal filaments of the auditory nerve are directly sent (Fig. 51, *s*).

Auditory Nerve; Origin and Distribution.—According to the investigations of Stieda in 1868, the auditory nerve springs by two roots from the medulla oblongata. The fibres of one of these are more delicate than those of the other. It originates from a ganglionic nucleus on the floor of the fourth ventricle. The second root, which is said by Stieda to contain larger axis-cylinders than any other nerve, springs from a special large-celled ganglionic nucleus in the crus cerebelli. This root acquires, soon after it leaves the medulla, a small ganglion, like one of the posterior roots of the spinal cord. Both roots soon unite into a common trunk, but divide again in the porus acusticus internus into two branches, the *vestibular* and *cochlear* branches.

Vestibular and Cochlear Branches of the Auditory Nerve.—The first contains a small ganglion, *intumescencia gangliiformis* Scarpæ, and divides into the ampullar branches and those for the utricle and the saccule.

The cochlear branch, which is by far the larger of the two, gives off a small fasciculus to the septum membranaceum between the saccule and the utricle, and to the macula cribrosa, and then enters the first turn of the lamina spiralis, from which point it continues its course throughout all the windings of the spiral lamina.

Ampullar Branches.—Duval and Laborde¹ showed that some of the fibres of the auditory nerve originate in a collection of motor cells in the bulb, and further, that these fibres are continued in the inferior cerebellar peduncles. The conclusion, therefore, is that there are two sorts of fibres in the auditory nerve,—*viz.*, sensory and motor,—and the branch possessing the latter function sends fibres to the ampullæ as well as to the cerebellum, and thus may be explained the reflex phenomena of disturbed equilibrium from irritation in the ampullæ and semicircular canals.

Inner and Outer Nerve-ends of the Cochlear Branch.—The ultimate fibres of the auditory nerve in the cochlea are named the inner and the outer terminal filaments, in accordance with their distribution to the inner and outer hair-cells.

According to Waldeyer, both sets of fibres, as they emerge from the openings in the lamina spiralis ossea, pass through the “granular layer” which lies directly over their point of exit. The inner nerve-fibres then pass directly to the inner hair-cells. These fibres are large, and are considered as true axis-cylinders. The outer nerve-fibres are distributed, as shown by Gottstein, between the pillars of Corti, at about half the height

¹ De l'Oreille, etc., Gellé, Paris, 1881, p. 323.

of the arches, to the inner row of the outer hair-cells, and perhaps to the more distant rows (Fig. 51, s).

The origin of the auditory nerve, being so near the origin of the pneumogastric nerve, will help to explain the sympathy which seems to exist between an aural disease and the respiratory and digestive tracts.

There also seems to be a sympathy between the ear and the emotions. May not cases of apparently hysterical deafness be traced to some such central nervous connection?

Soft Parts of the Vestibule and the Semicircular Canals.—Rüdinger¹ has shown that the sacculi and membranous semicircular canals of the internal ear are in direct contact with the osseous or cartilaginous structures containing them, and that, therefore, they do not float, as heretofore supposed, entirely free in the perilymph. The periosteum lining the bony cavity containing these membranous parts is a moderately thick layer of connective tissue with some fine elastic fibres.

The Sacculi.—The utriculus is more closely connected to the inner wall of the vestibule than is the sacculus rotundus. The two sacculi occupy two-thirds of the cavity of the vestibule. The utriculus extends farther outward towards the tympanum, but neither of them touches the side of the vestibule which receives the base of the stapes,—i.e., they do not touch the outer wall of the vestibular cavity (Plate I., 10 and 19).

The Membranous Semicircular Canals.—These are fastened to the convex side of the bony canals by means of stout connective-tissue fibres, which are called by Rüdinger the *ligamenta labyrinthi canaliculorum*. These constitute the true support of the membranous canals. Sometimes there are two or more of these connective-tissue stays, so arranged as to simulate under the microscope transverse sections of small canals. But they are to be regarded simply as part of the support of the membranous semicircular canals (Fig. 52, b).

Another set of connective-tissue fibres, passing from the periosteum to the free surface of the labyrinth wall, are for the purpose of supporting the blood-vessels as well as supplying points of fixation for the free wall of the membranous labyrinth (Fig. 52, d).

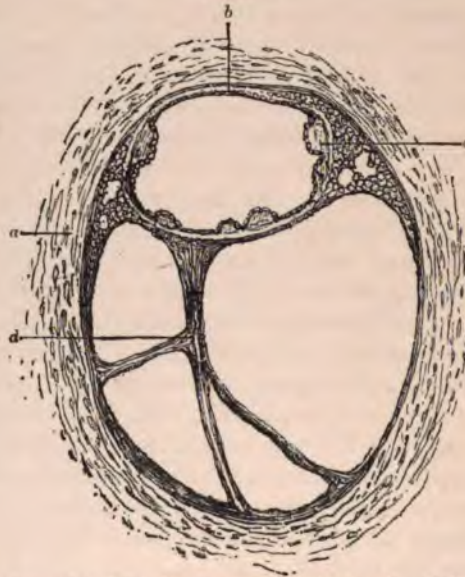
The wall of the membranous semicircular canals has an unequal thickness, being 0.016 of a millimetre thick at the point of contact with the periosteum and from 0.06 to 0.08 of a millimetre thick at the point of junction with the *ligamenta labyrinthi canaliculorum*. The canal wall is composed of four layers in the following order, from without inward,—viz., 1, a layer of connective tissue; 2, hyaline tunica propria; 3, papilliform prominences; and, 4, the epithelium.

The external layer possesses all the qualities of connective tissue with numerous cells. When the entire membranous semicircular canals,

¹ Das häutige Labyrinth, Stricker's Handbuch, Leipzig, 1872.

removed from their connection with the periosteum and ligaments, are subjected to examination, another net-work is found closely resembling nerves and ganglia. But it is as yet very uncertain whether these are nerve-elements, since the existence of nerves in the membranous semicircular canals is doubtful. The tunica propria is of unequal thickness in the semicircular canals, but in the utricle it is of uniform as well as great tenuity. The papilliform prominences on the inner surface of the tunica propria are by Rüdinger regarded as normal structures in the adult human being (Fig. 52, *c*). The papillæ are covered with pave-

FIG. 52.



Section through the osseous and membranous semicircular canals. (Politzer.) *a*, osseous semicircular canal; *b*, place of attachment of the membranous semicircular canal; *c*, elevations on the inner surface of the membranous semicircular canal; *d*, vascular bands of connective tissue.

ment epithelium, which is so easily detached that some observers have failed to find it at this point. These bodies are not found in the sacculi, nor at that part of the semicircular canals where the latter pass into the utricle.

Sacculi and Ampullæ; Inner Surface.—On the inner surface of these organs may always be found a peculiar yellowish epithelium provided with cilia. There is also a reduplication of the tunica propria extending into the cavity of the ampullæ, to which the name of *crista acustica* has been given by Max Schultze. A similar projection in the sacculi is called by the same authority the *macula acustica* (Plate I., 9 and 14).

Every branch of the acoustic nerve going to the ampullæ, after dividing into two flat fasciculi supplied with ganglion cells, passes

through the tunica propria, and is then distributed to the ciliated epithelium of the crista acustica.

Planum Semilunare.—At right angles to each end of the crista acustica, extending along the walls of the ampullæ, there is an elevation on the epithelial layer, named the planum semilunare.¹ To this also some of the terminal filaments of the auditory nerve are conveyed, as shown by Rüdinger.

The epithelial layer in the sacculi is thinner than that in the ampullæ, and contains several varieties of epithelium. But here, too, ciliated cells are found, to which nerve-filaments are sent.

The Otoliths.—In the endolymph of the sacculi are found small crystals of carbonate of lime, called otoliths. Some observers have found otoliths in the endolymph of the semicircular canals and in that of the cochlea, but these are generally considered exceptional occurrences. Henle, after treating the otoliths with acids, thought he detected a cartilaginous remnant, to which the name of otolith cartilage is given. They are, according to Rüdinger, large and few in reptiles, but small and numerous in man and other mammals.

The Topographical Arrangement of the Soft Parts of the Internal Ear.—By consulting Plate I. the general relations between the soft parts of the internal ear may be learned. It will be seen that the sacculus rotundus pertains more to the ductus cochlearis than to the utriculus and the rest of the so-called membranous labyrinth. The link between the sacculus and the ductus cochlearis is the canalis reuniens of Hensen (Plate I., 28).

The aquæductus vestibuli is the roundabout way from the utriculus to the sacculus. Of this peculiar duct more will be said hereafter. The utriculus, as shown in the diagram, is the cavity with which the membranous semicircular canals and their important ampullæ are in close connection. The entire membranous labyrinth is filled with endolymph.

The Endolymph.—The general plan upon which the endolymph and perilymph of the inner ear are renewed has been best explained by Hasse, of Würzburg.² He has shown that all vertebrates possess a duct which originates in the vestibule; and in all animals, with the exception of the plagiostomes, in which it passes directly to the surface of the skull, this duct enters the cavity of the cranium, and there terminates either in a closed sac at the confines of an epicerebral lymph-cavity or opens into the same. This is the ductus endolymphaticus or the aquæductus vestibuli, with the saccus endolymphaticus, the former of which arises from the sacculus rotundus in most vertebrates, and conveys endolymph to the membranous labyrinth.

Physiological Functions.—Hasse has suggested three probable functions of the aquæductus vestibuli, or the endolymphatic duct (Plate I., 27).

¹ Steifensand, 1835.

² Anatomische Studien, No. 19, S. 768.

1. The endolymphatic duct and its sac are the source of the endolymph in embryonal life. In this capacity the sac plays the part of a gland.

2. In adult life this duct may act as a conveyer of new material to the endolymph, either by endosmosis from the epicerebral cavities in those instances where the saccus endolymphaticus is closed or by means of a direct current where the saccus is open.

3. It may be supposed that the sac is useful as a reservoir for the liquor endolymphaticus when the intralabyrinthine pressure becomes excessive. By the reception of the fluid into this sac the pressure would be reduced in the labyrinth.

A very practical deduction is made by Hasse respecting the ductus endolymphaticus. Every increased or diminished pressure of the cerebro-spinal fluid in the subarachnoid cavity will make itself felt by continuity through the saccus and the ductus endolymphaticus, in the interior of the auditory apparatus, in the endolymphatic cavity, and upon the terminal filaments of the auditory nerve. Thus may be explained the impairment of hearing for high notes when the pressure in the labyrinth is increased. Furthermore, pathological processes in the subarachnoid space are conveyed, either by continuity or contiguity, through the saccus and ductus endolymphaticus, into the interior of the labyrinth, and *vice versa*, the latter being the rarer, from the deep-seated position of the inner ear. Thus, every alteration in the chemical constitution of the cerebro-spinal fluid necessarily produces a change in the liquor endolymphaticus, which alteration may exercise some influence in the occurrence of subjective acoustic perceptions, but in any event must change the composition of the endolymphatic fluid.

The Perilymph.—The perilymph is poured into the labyrinth from the subarachnoid space through the foramina acustica (Fig. 49, *a*), and leaves the labyrinth by means of the aquæductus cochleæ (Fig. 30, 17). The perilymphatic cavity exists in the lymphatic tract of all vertebrates,¹ and, being in connection with the subarachnoid space, it is easily seen how changes of any kind in the cerebro-spinal fluid may be communicated to the perilymph and thence to the organ of hearing. Hence morbid processes in the subarachnoid space may be communicated to the organ of hearing either by the perilymphatic or the endolymphatic tract, or by both ways at the same time. In this manner a plausible explanation may be given of numerous affections of the internal ear.

Hasse reiterates his views on the endolymph and perilymph in an article in the *Archiv für Ohrenheilkunde*, March, 1881, Bd. xvii. Heft 3, S. 194.

PHYSIOLOGY.

Cochlea.—The physiology of the perceptive part of the organ of hearing has been explained most satisfactorily by Helmholtz and Hensen, the

¹ Hasse, *op. cit.*, p. 815.

latter having made a series of experiments upon the function of hearing in the crab and lobster, since upon the surface of these animals there are largely developed cilia, endowed with peculiar vibratile functions, and probably connected with the organ of hearing.

It is now generally supposed that the cochlea enables man to perceive musical notes, or notes and sounds with regular periodic vibrations, and that the membranous labyrinth is concerned in the perception of irregular vibrations, which are distinguished as noises. In the labyrinth the distribution of the acoustic nerve may be traced to particularly firm and elevated spots at five different points,—viz., in the two sacculi and three ampullæ.

SCHEME OF RELATIONSHIP BETWEEN THE MIDDLE AND INTERNAL EAR.

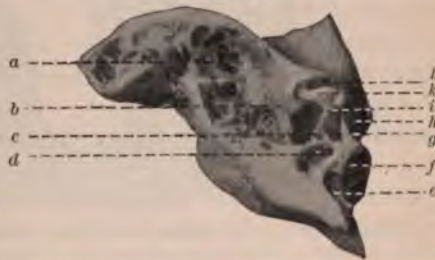
Schematic Description of the Middle Ear, of the Internal Ear, and of the Relation they bear to Each Other.—In order to understand the general features of the middle ear and of the internal ear, and the general relation they sustain to each other, let there be imagined, first, a broad and shallow barrel, closed at each end and divided transversely in the middle by a partition.

If this barrel be laid upon its side with one end towards the reader, it will give a fair representation of the *middle ear* in the near half and of the *internal ear* in the far half. The head of the near half of this barrel will represent the *membrana tympani* or drum-head, while the partition in the centre of the barrel represents the inner bony wall of the tympanic cavity. In this partition make an oval opening, and below and behind this a round one. The former represents the *foramen ovale*, or the oval window, and the latter, the *foramen rotundum*, or the round window.

From the membranous head of the near half of the barrel to the partition in the centre is stretched a bony bridge composed of three pieces,—viz., the malleus, or mallet, the incus, or anvil, and the stapes, or stirrup.

The handle of the outermost of the three ossicles, the manubrium of the mallet, is inserted into the fibrous or middle layer of the drum-head; the innermost, the stirrup, by means of its foot-plate, fits into the oval

FIG. 53.

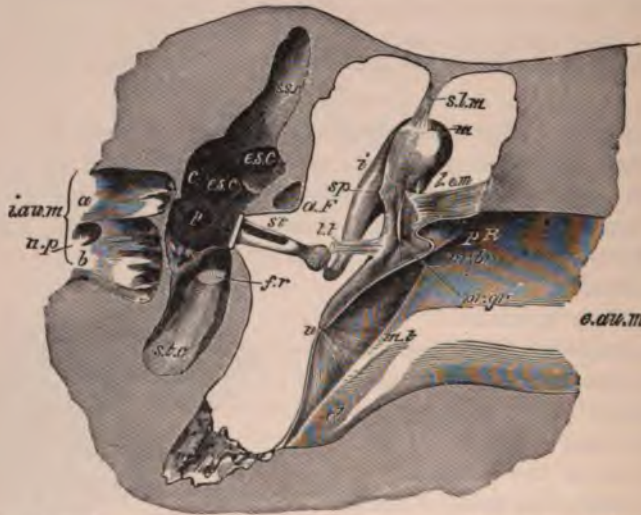


Horizontal section through the left auditory apparatus, viewed from above; photographed from nature. *a*, mastoid cells; *b*, aditus and antrum; *c*, stapes in oval window of vestibule; *d*, vestibule; *e*, internal auditory canal for acoustic nerve; *f*, vertical section of cochlea, through modiolus; *g*, cochlear process for tendon of tensor tympani; tendon passing to malleus; *h*, membrana tympani; *i*, descending limb of incus, joining stapes; *j*, malleo-incudal joint; *k*, outer wall of attic.

window in the inner wall of the tympanic cavity, and the middle bonelet, the anvil, is held in position between the other two. They are furthermore held together and fastened to the roof and wall of the tympanic cavity by means of ligaments (Figs. 30 and 54).

This bridge of ossicles may be said to have two guys which steady it and give it proper tension, one of which is fastened to the mallet and the other to the stirrup. The former will at once be recognized as the tensor tympani and the latter as the stapedius muscle.

FIG. 54.



Profile view of the left tympanum and part of the internal ear, from before and somewhat from above, the anterior part having been cut away; magnified four times. (After Quain.) *m*, head of the malleus; *sp*, lower anterior part of the prominent border of the articular surface; *pr.br*, short process of the malleus; *pr.gr*, root of the processus gracilis, cut; *s.t.m*, suspensory ligament of the malleus; *l.e.m*, external ligament of the malleus; *t.t*, tendon of the tensor tympani, cut; *i*, incus, and below its process; *st*, stapes in the fenestra ovalis; *e.au.m*, external auditory meatus; *p.R*, incisura Rivini; *m.t.*, membrana tympani; *u*, umbo of the membrana tympani; *d*, pouch between the membrana tympani and the lower wall of the external auditory canal; *i.au.m*, internal auditory canal; *a, b*, upper and lower divisions of the parts of the auditory nerve; *n.p*, canal for the posterior ampullar nerve; *s.s.c*, ampulla of superior semicircular canal; *p*, posterior ampulla; *c*, common crus of the superior and posterior semicircular curves; *e.s.c*, external ampulla; *e.s.C*, external semicircular canal; *s.t.c*, scala tympani cochleæ; *f.r*, fenestra rotunda, closed by the membrana tympani secundaria; *a.F*, aqueductus Fallopii, or facial canal.

In the outer half of the imaginary barrel are two bung-holes, one in front, the other on the back. The front bung-hole represents the tympanic opening of the Eustachian tube, by means of which the middle ear, or drum, is ventilated and the atmospheric pressure on each side of the drum-head equalized. The back bung-hole is the communication between the mastoid cells and the cavity of the tympanum (Fig. 34, *c* and *g*).

The mastoid portion may be likened to an ivory box filled with sponge, the latter representing the series of bony cells, which communi-

cate with one another and at last, by means of the tympanic antrum, with the cavity of the middle ear. In this simple manner the middle ear, with its ossicles and more important appendages, may be sketched. The functions of this cavity are dependent on aërial life and equal pressure of air on each side of the drum-head.

This air-containing cavity is separated from the internal ear, or labyrinth, a *water-containing* cavity, by means of a bony partition,—viz., the inner wall of the middle ear already described,—in which is the oval window into which the foot-plate of the stirrup fits. Hence these two important cavities have one wall in common through which, by means of the foot-plate of the stirrup, the movements of the chain of little bones are communicated to the fluid of the internal ear and to the thread-like ends of the nerve of hearing suspended in it (Fig. 54, *st*).

In order to understand the general features of the internal ear, let us still retain the simile of the barrel. In this instance the inner half of the barrel must be regarded as made entirely of bone, as filled with water, and as communicating at *no point* with the atmosphere, but in direct communication with the arachnoid space by means of the aqueducts of the vestibule and cochlea.

As the walls of the internal ear are made of bone, there can be no yielding on their part to the pressure of the fluid of the labyrinth produced by the movements of the stapes. In order that these movements may go on, there exists at the extremity of one of the passages of the internal ear—viz., the cochlea—the round window, over which is stretched a membrane which yields slightly to the pressure brought about in the labyrinth by the movements of the stapes.

On the front of this inner cavity representing the *internal ear* is a spiral tube with two and a half turns. Being coiled like a snail-shell, it long ago received the name of *cochlea*.

On the back of this inner cavity are five openings communicating with three semicircular tubes. We would naturally look for six openings into the ends of three semicircular tubes, but only five are found in this instance, as two ends of two of the semicircular tubes—viz., the superior and posterior semicircular canals—join together and have a common opening into the internal ear or labyrinth at that part of it called the *vestibule* (Plate I.).

On the farther wall of this inner space we find the nerve of hearing entering the labyrinth through a *sieve-like spot*. After pushing its way into the cavity of the internal ear through this sieve-like spot in the inner bony wall of the internal ear, at the fundus of the internal auditory canal, the auditory nerve divides into two main branches, one of which, the cochlear branch, is distributed to the cochlea, and the other, the vestibular branch, is given to the sacculi and to the ampullæ of the semicircular canals (Plate I.).

CHAPTER VII.

INSTRUMENTAL EXAMINATION OF THE EAR.

Source of Light.—The light used in examining the ear may be sunlight, electric light, gas-light, or lamp- or candle-light. These may be used either directly or by reflection.

Reflected Light.—The most usual method of illuminating the external auditory canal and the membrana tympani is by reflecting the light from a mantle gas-burner into the ear through aural specula, by means of mirrors yet to be described. The flame of the light thus used should be about four and a half feet above the floor, and the patient should sit beside it, with the ear to be examined turned away from the light.

FIG. 55.



Forehead electric lamp in position.

FIG. 56.



Hand otoscope, one-half natural size.

Direct Light.—Direct sunlight may be thrown into the ear after the patient is placed favorably for this purpose, or the external canal and the membrana tympani may be illuminated by direct light from an electric lamp held on the surgeon's forehead, as shown in Fig. 55. Electric illumination by this means is the only form of artificial light that can safely be brought near the ear of the etherized patient.

Ear-Mirror, or Otoscope.—The instruments used in the ocular examination of the ear should be as simple as possible. They must consist of at least a concave hand-mirror with a focal distance of from four to six inches, and a nest of four so-called specula, or ear-funnels. That form of hand otoscope known as von Troeltsch's ear-mirror is the simplest and the best (Fig. 56).

The Forehead Ear-Mirror.—Equally as important as the hand ear-mirror is the forehead ear-mirror. It consists in the attachment of the same kind of a mirror as the former firmly to a forehead band of inelastic silk. There are many forms of attachment, but a ball-and-socket joint,

FIG. 57.



Illumination of the ear by means of the forehead-mirror during insufflation of a powder.

that can be tightened or loosened as required, in which the ball of the joint is close to the periphery of the mirror, and in which the joint lies in the centre of the band, is the best, because, with the mirror thus brought so near the point of fixation, the greatest firmness is obtained. It is not necessary—in fact, it is best not—to endeavor to look through the hole in the centre of the mirror when on the forehead, but to look under it or to one side of it. In every instance the mirror must first be adjusted with the hand, so as to throw the light to the best advantage into the speculum and canal. Then the operator can keep up the illumination of the ear by holding the mirror in the desired position by his head, while his hands remain free. The manner of its use can be seen by consulting Fig. 57.

Otoscopes, or Aural Specula.—The next want will be a nest of specula or ear-funnels. There are numerous forms found in the instrument-makers' shops, under the names of Kramer, Toynbee, Wilde, Gruber,

Politzer, and others. While all are good, preference should be given to Gruber's specula, because a transverse section of their caliber at right

FIG. 58.



Gruber's aural specula.

angles to the long axis most closely resembles a similar section of the auditory canal,—i.e., it is slightly ovoid in shape. The great object in using a speculum or aural funnel is simply to hold the tragus away from the meatus, and to push away the stiff hairs about the opening of the external auditory canal.

In some cases moderate dilatation of the cartilaginous canal may be effected, but usually all endeavors at dilatation of the external auditory meatus are worse than useless,—they are painful and injurious.

Siegle's Pneumatic Otoscope.—Siegle's pneumatic otoscope consists of a hard rubber, round speculum, like Politzer's, to which is attached an air-tight chamber three centimetres in diameter. The upper or outer wall of this chamber is of glass, and forms an angle of forty degrees with the plane of the inner wall. On the longer side of the chamber there is an opening with a perforated knob, to which is attached a piece of rubber tubing about a foot in length, ending in a mouth-piece for the surgeon. This chamber is made to screw on and off ear-funnels of different diameters. When all the parts are fully adjusted, the surgeon has an air-tight speculum with a glass end, through which he can examine the movements the drum-membrane makes during condensation and rarefaction of the air, brought about by his own mouth through the rubber tubing at the side of the instrument. This is really the only means the surgeon has of fully determining the mobility of the drum-head, though both Valsalva's and Politzer's methods of inflation, if carried out while the surgeon's eye is fixed on the drum-head, will give him some idea of the extent to which the membrane can move. But when the Eustachian tube is impervious, Siegle's instrument is the only means of determining the mobility of parts or of the whole of the membrana tympani. Gorham Bacon improved this instrument by adapting to the air-chamber Gruber's specula in place of round ones.

Burnett's Modification of Siegle's Pneumatic Otoscope.—This is practically a metallic Gruber speculum transformed into a Siegle pneumatic speculum, or otoscope, by the addition of a glass lid (Fig. 59). Its extreme length is five and one-half centimetres, and its diameters at its meatal end are six millimetres vertically and four millimetres horizontally. This renders it more adaptable to the shape of the meatus. It is nickel-plated both within and without, which gives it a better reflecting surface than that possessed by black instruments. Two small openings on its inner wall, at the point of junction with the air-tube, act like a sieve, to prevent the drawing up of particles of cerumen or dirt into the

operator's mouth, another advantage over the ordinary Siegle instrument. The attachment for the air-tube is on the lower side of the speculum, so that there is only a gentle vertical curve of the suction-tube instead of the double bend which existed in the old form of the Siegle instrument with the air-tube attachment at its side. The chief advantage, however, lies in the meatal end of the speculum, which rapidly widens for a distance of a centimetre from the end to a diameter of eleven millimetres vertically and ten millimetres horizontally, thus giving a graduated end fitting hermetically into any adult meatus without the necessity of adding rubber



FIG. 59.



Burnett's modification of Siegle's pneumatic otoscope.

packing or substituting another speculum with smaller or larger diameters, as in using the old forms of the hard-rubber Siegle otoscope.

Position of Patient's Body and Head.—The most usual way of examining the ear is by reflected light (page 76). The patient may lean back or sit high and straight in the chair, but the axis of his body should be inclined neither to the right nor to the left. His head should be inclined somewhat towards the shoulder opposite to the ear to be examined. It is important for the comfort of the examiner that the body of the patient should not be inclined away from him, for if it be, a great strain comes on the back of the surgeon in his endeavor to reach after the ear.

Position of Surgeon.—The surgeon, standing beside the patient, in front of the ear to be looked into, should grasp the auricle at its upper and posterior margin gently between the index and middle fingers of his left hand, and pull it a little upward and backward. This is always to be done with the left hand, no matter which ear is examined. This leaves the right hand free to hold the mirror. The patient should be placed, and the surgeon should stand, so that the light may fall on the mirror towards the surgeon's right side or directly from in front—never from the left—in the above position of patient and examiner. These rules as to position of light, patient, and physician are especially important when artificial and reflected light is used.

Insertion of Ear-Speculum.—With the auricle grasped as directed above, between the index and middle fingers of the left hand, the speculum or ear-funnel may be gently inserted in a direction slightly downward, inward, and forward, or in general terms towards the patient's nose, by the other hand, and then grasped at the edge of the wide end by the thumb and index of the left hand. Or it may be inserted by the thumb and index of the left hand at the same time that the index and middle

fingers grasp the superior posterior margin of the auricle. In the latter instance a very gentle and slight rotation will suffice to place the ear-funnel properly. The speculum being now in the meatus, light is to be reflected into it from the mirror.

The first point to be determined, in making an examination of the ear, is whether or not the auditory canal is entirely free from obstruction. If it is, the eye of the observer should, after ascertaining the state of the wall of the canal, seek the membrana tympani. The chief obstacle in such a search is usually the misdirection of the axis of the funnel. This, instead of being made to correspond with the axis of the auditory canal, is by the unskilled usually so directed that the light falls upon the sides of the canal or only partially on the drum-head. Hence it is not at all uncommon to hear a diagnosis made for the membrana tympani which is based entirely on a view of the condition of the skin lining the auditory canal.

What should be seen at the fundus of the canal is described on pages 16 to 20, yet it will be a long time before the eye can so accommodate itself to the conditions of illumination in the external ear as to interpret fully what it sees. The experienced eye is able to resolve into depressions, elevations, curves, etc., things which to a beginner seem to be entirely in the same plane.

FIG. 60.



Forceps for removing foreign bodies from the ear.

Removal of Obstacles to a View of the Membrana Tympani.—It requires but a small object—a few stiff hairs or a flake of cerumen or of epithelium—to obstruct the view of the drum-head. All such obstacles are most easily removed by a few syringe-fuls of warm water, which will, however, render the drum-head a little macerated, and thus deprive it of whatever lustre it may have had. This must be borne in mind in looking at the drum-head after warm water has been syringed upon it. Therefore, when it is especially desirable that the amount of natural lustre in a

given case should be estimated, an obstructive substance might better be gently and most carefully lifted or wiped out of the canal. The former is most readily accomplished by the slender forceps shown in Fig. 60, while the canal is thoroughly illuminated by the forehead-mirror (Fig. 57). If the obstruction to vision can be wiped or swabbed out, the cotton-holder, with its little wad of cotton at the roughened end, will enable one to do this.

The Cotton-Holder.—This is a most useful instrument, both for cleansing the ear and for conveying medications to diseased surfaces in the organ. The shaft is flexible for an inch or two and roughened at the tip, around which a small tuft of absorbent cotton may be coiled, and then used, as already indicated, for cleansing and treating the ear. The cotton is removed from the holder by twisting it off in the direction opposite to that in which it was wound on, or it may be burnt off (Fig. 61).

During all these procedures for removing small obstructions to a good view of the drum-head the canal is supposed to be most carefully illuminated by light reflected from the forehead-mirror, and the operations performed by a skilled hand.

If the methods suggested should be inadequate to remove obstacles in the auditory canal, recourse may be had to syringing. The syringe should be carefully chosen; one that holds two fluidounces will be large enough, though both larger and smaller ones may be used. The syringe should work perfectly, being neither too loose nor too tight in the piston. There is an excellent syringe for aural purposes always at hand in the hard-rubber enema syringe, No. 2. At this point it may be said, unhesitatingly, that all forms of syringes sold in the drug-stores and elsewhere, under the high-sounding name of "ear-syringes," are uniformly dear and as uniformly worthless.

Syringing the Ear.—In syringing the ear, cold water must never be used. Let the water be pleasantly warm. A china basin with a partition dividing it into two compartments should be employed. The clean water should be in the side nearest the surgeon, the empty compartment under the patient's ear to catch the return current. Provided with an aseptic syringe, as well as with a receptacle for holding and catching the water, let the surgeon grasp the auricle between the thumb and forefinger of the left hand and pull it gently upward and backward. With the auricle thus held, let the syringe be emptied slowly but firmly into the auditory meatus. Point the syringe downward and forward towards the patient's nose. The current from the syringe should be thrown along the upper

FIG. 61.



Cotton-holder.

wall of the auditory canal, thus permitting the return current to pass along the floor of the canal.

FIG. 62.



Eustachian catheter.

In some cases considerable force may be used in throwing the current of water into the canal, as, for example, when it is desired to remove a foreign body from the fundus of the canal or when the canal is blocked up with a large and adherent wax plug. I have found it decidedly advantageous to give to the syringe a gentle spiral motion as the current of water is going into the meatus. This impulse conveyed to the water will thoroughly wash off all adherent matters from the wall of the auditory canal.

Examination of the Nares and Fauces, Throat, and Eustachian Tube.—The inspection of the nares, fauces, and throat, and the examination of the state of the Eustachian tube form a most important adjunct to a complete aural examination.

Eustachian Catheters.—The ocular examination of the Eustachian tube ceases with the rhinoscopic view of the faucial extremity; beyond that point the examination becomes entirely aural, by means of the Eustachian catheter and the auscultation-tube. The Eustachian catheter consists of a tube of metal or hard rubber, curved at the beak as seen in Fig. 62, *a*. The conical handle must be made so as to permit the end of the air-bag to fit accurately into it, and the ring or button (Fig. 62, *b*) upon the handle should be firmly attached to each instrument in the same plane with the circle of which the curved beak is an arc. By observing the position of the button or ring-indicator, one can always know the precise position of the beak of the catheter.

The Auscultation-Tube.—This instrument is the highly important adjuvant of the Eustachian catheter; in fact, in so far as the latter is of aid in an objective examination, it owes that power to the auscultation-tube. The latter consists of a yard of rubber tubing, eight millimetres in its outside diameter. Black rubber tubing is preferable, being more lasting and less sulphurous in odor than the ordinary domestic white rubber tubing. Upon one end of this tube there should be a white bone end-piece made to fit the surgeon's ear; at the other end there should be a black end-piece for the patient's meatus. In using the auscultation-tube, one end should rest snugly in the meatus of the ear catheterized, while the other end must rest equally well, though not too tightly, in the examiner's ear.

Let it be supposed, for example, that the patient's left ear is to be catheterized, and that the auscultation-tube is also to be used. Let the examiner place his end of the auscultation-tube in his left ear and bring the

tube loosely around behind his neck and over his right shoulder, placing the other end of the tube in the patient's left ear. If the tube be thus

FIG. 63.

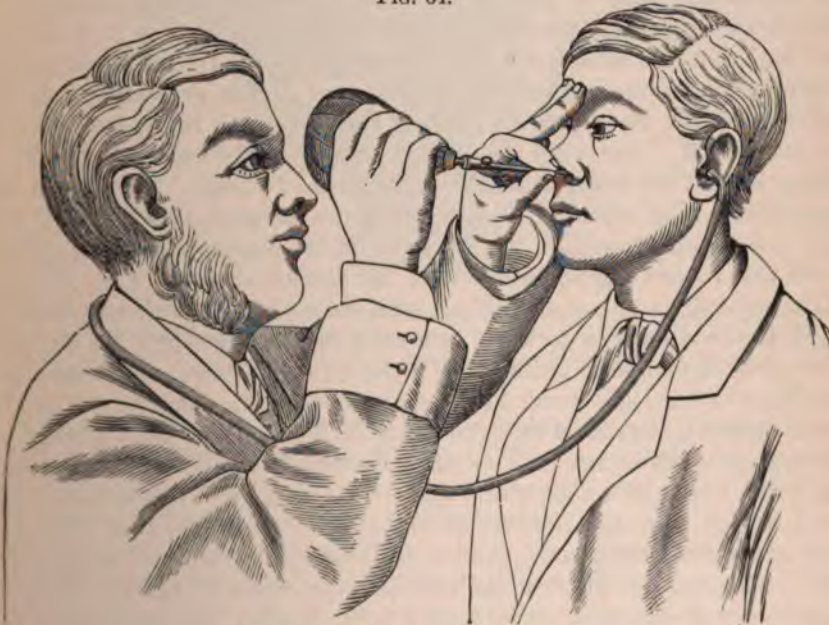


Auscultation-tube.

supported, it is less in the way of the surgeon and less likely to fall either out of his or the patient's ear.

The method usually given in most works on aural surgery is to allow one end to rest, for instance, in the patient's left ear, while the other end is resting in the surgeon's right ear. In such a case not only will the tube hang down between the patient and surgeon and be in the way, but its mere weight when thus suspended is sufficient to drag it out of place.

FIG. 64.



Hand inflation-bag in the Eustachian catheter.

The Hand Inflation-Bag.—The general appearance of the hand inflation-bag is shown in the hand of the surgeon in the annexed figure (Fig.

64). The use of this bag is to force air through the catheter into the Eustachian tube and tympanic cavity. It is of the greatest importance that the end-piece, or so-called "mount," at the distal end of the bag should fit accurately into the catheter, and, like it, be of hard rubber. During the expulsion of the air from the bag, great care should be taken not to force the axis of the bag out of line with that of the catheter, for, should this occur, either by an upward or downward movement of the hand and wrist, the catheter, if of hard rubber, will be very apt to break; if of silver, to bend. In compressing the air-bag, no motion should occur, except in the fingers of the right hand or the hand employed in compressing the bag. A little practice will enable the operator to make only such a motion with the fingers, though at first there is an almost involuntary tendency to flex the hand laterally on the wrist towards the ulna at the same moment that the fingers are made to squeeze the bag. The bag must be removed from the catheter after each inflation, in order to renew the air in it. Any other form of inflation whereby this removal is obviated tends to draw fluids from the nares into the catheter.

Catheterization of the Eustachian Tube.—Provided with the three instruments described in the preceding pages,—viz., a catheter, an auscultation-tube, and a hand air-bag,—the surgeon may endeavor to catheterize the Eustachian tube by placing the beak of the Eustachian catheter in the faucial end of the Eustachian tube, so as to enable him to force air into the latter and thence into the tympanic cavity. In catheterizing the Eustachian tube the patient may sit or stand. It is preferable that the patient sit with his hips well back in the chair and his spinal column and head erect. The latter may be placed against the wall or the back of a chair should the latter come above the patient's head. Then, with the auscultation-tube adjusted as described, the surgeon should place the fore- and middle fingers of the left hand on the patient's forehead a little above the root of the nose, and with his thumb should lift up the tip of the patient's nose and hold it up until the catheter is well inserted.

With the tip of the patient's nose held as just described, let the surgeon grasp the catheter as he would a pen-holder, between the thumb and forefinger of the right hand, holding his hand down about as low as the patient's chin, towards which the palm of the catheter hand should be turned. Now insert the beak of the catheter into the nostril corresponding to the ear to be catheterized, and with a compound upward and forward motion pass the instrument along the floor of the nose until the beak reaches the nasopharynx and at last touches the posterior pharyngeal wall. The ring or button at the proximal end of the catheter, which the surgeon always keeps in sight, should point directly downward upon the arrival of the catheter beak in the nasopharynx. With the catheter's distal end at the posterior pharyngeal wall, the beak may be turned outward towards the ear to be catheterized. By this motion the beak will slip into the fossa of Rosenmüller (Fig. 65, *g*). At this point there is usu-

ally made the mistake of supposing that the catheter's beak rests in the mouth of the Eustachian tube, and consequently unsuccessful attempts at inflation are made. But in order to place the beak of the catheter in the mouth of the Eustachian tube the following manipulation becomes necessary. After the beak of the catheter has been turned into the fossa of Rosenmüller, draw the catheter forward, letting the beak slip over the posterior lip of the Eustachian tube (Fig. 65, *h*), and as this is done turn the catheter so that the ring-indicator will point towards the ear catheterized at an angle of forty-five degrees. At the moment this

FIG. 65.



Vertical section of the nasopharynx, with the catheter introduced into the Eustachian tube, right side. *a*, inferior turbinate bone; *b*, middle turbinate bone; *c*, superior turbinate bone; *d*, hard palate; *e*, velum palatum; *f*, posterior pharyngeal wall; *g*, Rosenmüller's fossa; *h*, posterior lip of the orifice of the Eustachian tube.

movement is made with the catheter, its beak slips into the faucial extremity of the Eustachian tube (Fig. 65). This is not easily done; but fortunately it is an operation rarely if ever needed, and should never be performed except by an expert in aural surgery.

Fixation of the Eustachian Catheter.—After the catheter has been thus put in place, let the thumb and forefinger of the left hand grasp the instrument close to the nose, while the remaining three fingers are braced above the root of the patient's nose at the point formerly occupied by the middle and index fingers during the elevation of the tip of the nose by the left thumb and the insertion of the catheter by the right hand (Fig 64).

With the catheter thus fixed in position, and the auscultation-tube

passing from the patient's ear to the ear of the examiner, the latter may grasp the hand air-bag and make inflations into the tube and tympanum. If the Eustachian tube is pervious, air will be heard to enter it with more or less force. As a rule, two or three inflations from the air-bag will be sufficient to properly and safely ventilate the middle ear. In using the Eustachian catheter the greatest danger is from emphysema of the nasopharynx and pharynx, even including the glottis. This will not occur, however, if the mucous membrane of the mouth of the Eustachian tube has not been lacerated and the air-bag then used with great expulsive force.

Inflation of the Tympana by Politzer's Air-Bag.—Poltzer's hand air-bag consists chiefly of an ordinary air-bag such as is used for forcing air through the Eustachian catheter. Instead of the conical tip of the ordinary hand air-bag, the instrument devised by Politzer is supplied with a somewhat bulbous tip, to which is attached a piece of black rubber tube eight centimetres long, which forms the pliable connection between the

air-bag and the nose-piece. The latter piece is made of hard rubber, and varies from three to four millimetres in diameter. It is curved slightly at the beak, and resembles at this point a coarse Eustachian catheter (Fig. 66). In fact, one may extemporize a Politzer's apparatus by attaching an ordinary hard-rubber catheter to the hand air-bag; but in this case the disadvantages are the stiffness of the catheter and its great liability to snap in half.

Poltzer's method of inflation depends upon the physiological fact that, at the moment of swallowing, the velum palati rises and thereby draws the anterior wall of the Eustachian tube from the posterior. At this moment the faucial extremity of the tube is so patulous that air forced through the nares, not being able to pass downward into the fauces and mouth, because the velum palati prevents it, will by following the course of least resistance pass into the tube and usually into the tympana.

In order to accomplish this result at the desired moment, the patient is instructed to take a sip of water and retain it in his mouth until told to swallow. After the water has been thus taken, let the surgeon place the curved nose-piece into either nostril and com-

press the nostril in front of the nose-piece. The usual error is made in trying to compress the ala of the nostril down upon the nose-piece.

FIG. 66.



Poltzer's air-bag for inflating the middle ears; one-third natural size.

This is very painful to the patient, is apt to make him jump, and thus the surgeon is defeated. The index-finger should compress the other nostril so that no air from the bag shall escape outward through the nose. The point of the nose-piece should be directed outward against the ala rather than inward against the bony septum. If the latter is done, and it usually is the mistake of beginners, the septum will be painfully pressed if not wounded, and bleeding from the nose may be the very undesirable result.

In using this method of inflation, one ear of the patient may be connected by the auscultation-tube to the ear of the surgeon; but this is by no means necessary, since, as a rule, when the method is properly carried out, a peculiar resistance or recoil ensues in the inflation-bag, which the surgeon soon learns to recognize.

By the very nature of the physiological process called to aid in Politzer's method of inflation, consisting in forcing air from the inflation-bag while the nostrils are compressed during the act of swallowing, both ears are likely to be inflated at the same time (Fig. 67). The fact that one ear cannot be isolated at will during this mode of inflation should be borne in mind. If for any reason such isolation on the part of either ear should be demanded, the surgeon must resort to the catheter. The force of the Politzer inflation, however, can in any case be augmented on either side by pressing the finger firmly into the canal of the ear opposite to the one it is specially desired to ventilate. By some it is thought that this latter modification is aided by holding the head over towards the shoulder opposite to the ear which is to receive the greater amount of inflation. As in such a position the ear on the up-turned side is highest, the supposition is that the air may take its course more readily towards that ear than the one turned downward and firmly stopped by the finger. Instead of swallowing water to insure the elevation of the palate, the surgeon may command the patient to say "hick" or "hack" (Gruber), or "aa" (Lucae), or the patient may simply distend his cheeks with closed lips (E. E. Holt), thus forcing the root and dorsum of the tongue against the velum.

Inflation by Politzer's air-bag, like inflation of the tympana by the Eustachian catheter, must be used with the greatest caution. *It is rarely needed as a therapeutic means, and should never be applied except by an expert.*

FIG. 67.



Inflation of the tympana by Politzer's air-bag.

CHAPTER VIII.

TESTS OF HEARING.

Aërial and Bone-Conduction of Sound.—Sound is normally conveyed to the auditory nerve by the passage of sound-waves into the external auditory canal, and by the oscillations of the membrana tympani and ossicles which these sonorous waves produce. Sound may also be conveyed to the auditory nerve by the vibrations it produces in the osseous tissues of the head; the waves of sound, in the latter instance, being conveyed directly to the walls of the labyrinth, and thence to the terminal filaments of the acoustic nerve. The former mode of conveyance of sound is called aërial, and the latter mode, bone-conduction of sound. In bone-conduction it is probable that some of the waves of sound falling on the ossicles set them in motion, and thus some of the sound is conveyed to the perceptive apparatus in the labyrinth.

Normal Hearing.—No precise standard of normal hearing has ever been defined. The normal ear hears all sounds that fall on it; but it cannot be said, *a priori*, where good hearing ceases and defective hearing begins, for in many senses these are relative terms.

The sense of hearing must be regarded as composite,—*i.e.*, it consists in the ability to hear a number of different sounds both periodic and irregular in their vibrations. Such sounds can be heard singly or together. Hence the sense of hearing may be said to lie in a collection of nervous elements which can be aroused separately or together. The latter is shown by the well-known fact that more than one sound can be heard at the same time.

The Watch.—Some form of watch-work or ticking apparatus is an old and ready means of testing the hearing. In this way the pocket watch, mantel clock, metronome, or an especially contrived ticking machine has been called into requisition. But the watch being a low form of musical instrument, at best giving forth only two poor notes, not easily determinable in pitch, can never have a wide application as a test. When using a watch as a means of determining the hearing, the test is being accomplished with only one or at most two notes. Now, if a defect in the conducting or in the perceptive auditory apparatus interfere with hearing notes given out by the test in a particular case, the watch will not be heard, or but imperfectly, whereas a watch the notes of which are of a different pitch might be heard. Hence it is that the watch as a test so often fails.

The simplest and most convenient form of watch-test is the ordinary

pocket time-piece. When using it as a means of testing the hearing, the watch should be brought from a point where it is not heard, gradually towards the ear, until the ticking is perceived by the patient, or until positive inability to hear it, even on contact with the head, is discovered.

The distance at which the watch used is heard by the normal ear should be known by the examiner. This distance may represent the *denominator* of a fractional form of expressing the hearing power; the *numerator*, the distance heard in a given case. Thus, a watch is heard by the normal ear sixty inches and by a diseased ear in a given case twenty inches. The record in such a case would be expressed by the fractional formula $\frac{20}{60}$ inches. (J. S. Prout.)

The Stop-Watch.—Of all forms of watch-work for testing the hearing, the most useful is the stop-watch. Besides its power as a test, there is also in it the means of finding out whether the patient really hears the sound of the watch, or whether he *thinks* he does because he knows a watch is being held before his ear. This means is often the first to detect the unreliableness of the patient's statements respecting his subjective impressions of sound.

If the ticking of the watch can be alternately stopped and set going at the will of the surgeon, errors of observation on the part of the patient may be detected. The same end has been gained by alternately holding and removing a diaphragm of paper between the ear and the watch.

In some cases, even while the ticking continues, the patient will state that he no longer hears the sound of the watch. This may be a perfectly true statement, and is explained by the fatigue of the diseased ear. As will be shown later, some ears affected by chronic aural catarrh manifest this tendency to grow fatigued and to cease to hear a sound while listening attentively to it.

As a test for bone-conduction, the watch is limited both by the age of a patient and by the weakness of its impact. The latter may be overcome by having the ticking apparatus so constructed as to give its sounds with great intensity.

The Tuning-Fork.—There are several forms of tuning-fork used in making tests of the hearing. The best results are obtained with a large instrument giving a powerful fundamental note.

An instrument which has given satisfaction, and which can be supplied at moderate cost, is the clinical tuning-fork (Fig. 68). The instrument is set in vibration by gently tapping it against any firm object, at one of the short stems on the clamp.

While the force thus applied is not always the same, practice will enable the surgeon to apply nearly the same amount of force in every case. The instrument possesses the advantage of great convenience and simplicity; it is twenty-six centimetres long, and gives out a full, deep

note, free from discordant overtones, when the clamps are properly adjusted at the points. By altering the position of the clamps the fundamental note is changed.

FIG. 68.



Clinical tuning-fork.

Politzer¹ has devised an acoumeter, consisting of a hard-rubber tube four centimetres in length, in which is a steel cylinder twenty-eight millimetres long and four millimetres in diameter. Above the latter is a small hammer, which is made to strike the steel rod by touching a spring. There is attached to one side of this instrument a small pedestal, which supports the acoumeter against the head when it is desired to test the perceptive power of the auditory nerve through the bones of the cranium. All these instruments are said to be made alike, and are attuned to the note c". The inventor claims for this instrument the advantage of supplying a standard unit of measurement of hearing.

The Use of the Tuning-Fork in Diagnosis.—The tuning-fork is used in two ways, as a test of hearing and as an aid in diagnosis: 1. By aerial conduction of its vibrations, in which instance, the instrument being held near the ear, its sound reaches the conducting apparatus in the most favorable way,—viz., through the air. 2. By bone-conduction, as it is termed, in which the vibrations of the tuning-fork are communicated chiefly directly through the tissues of the face and cranium to the conducting apparatus and also to the perceptive organs. The normal ear, in a normal skull, is always possessed, at the same time, of these two ways of sound-conduction to the auditory nerve; but the normal ear is not conscious of this ability to hear by bone-conduction, because it perceives sound so much better by aerial conduction than it can through the bones of the head. Therefore, it is not until the normal or aerial mode of sound-conduction is interfered with by obstructive disease in the sound-conductors that the ear, in its abnormal state, becomes conscious of the conduction of sound through the tissues of the head. This is especially marked when the vibrations of sound are communicated directly to the bones of the cranium by placing the handle of the vibrating tuning-fork upon the vertex, or glabella. Then, if aerial conduction is obstructed, the auditory nerve still retaining its function, the affected ear becomes conscious of a loud volume of sound from the tuning-fork vibrating on the vertex, or glabella. These phenomena are, however, only those of modified sound-conduction, and from them can be drawn, for the most part, conclusions respecting only the condition of the conducting apparatus of the ear.

¹ K. K. Gesellschaft der Aerzte, Wien, March 2, 1877.

Age does not seem to have much to do with the ability to hear by bone-conduction, provided that the fork used is powerful. If the auditory nerve perceives at all, individuals over eighty years of age usually hear the fork vibrating on the vertex; but doubtless it requires powerful vibrations to make themselves felt through the head-bones of the aged. When bone-conduction in the aged seems to be impaired, it is due probably, as Moos has suggested, to a diminished sensibility of the auditory nerve. Then, too, the musical education or sense of the patient, as well as the perceptive powers, must be taken into consideration; otherwise hearing will often be confounded with feeling. It has been found that deaf-mutes might, to some, appear to hear the tuning-fork vibrating on the vertex, were it not known that what they perceive in such conditions are vibrations at the diaphragm.

Tuning-Fork vibrating on a Parietal Protuberance in a Normal Case.—If a vibrating tuning-fork be placed on either parietal protuberance of a person with normal hearing, it will be heard in the opposite ear. This is most easily perceived when a large and powerful tuning-fork of low note is used. This phenomenon, if it may be so termed, will often lead to confusion in diagnosis, inasmuch as the examiner would expect the fork to be heard better in the ear nearest to it. As it is heard better in the more distant organ, a conclusion might be reached that the latter is diseased in its conducting parts. This may be due to the fact that vibrations which fall perpendicularly on the membrana tympani produce the strongest vibrations, and hence a tuning-fork placed on the parietal protuberance, or on the side of the head, will be heard chiefly in the opposite ear. This is very distinctly perceived if both meatuses are stopped, but it is equally perceptible, as any one can find out by experimenting upon himself, with the meatus open. Care must, therefore, be taken to have the vibrating instrument in the central line of the head, either on the vertex or glabella, or held in or on the teeth.

The tuning-fork finds its greatest usefulness in testing by bone-conduction. While it has never fully realized in this way all that was hoped for it as an aid in diagnosis, it is still the best means, and a very good one, too, of determining how much sound is perceived by the auditory nerve through the bones of the head.

Its musical nature, as well as its powerful vibrations, renders it far superior to the watch as a test for the conducting power of the bones of the head, unless the ticking of the watch be made to occur with great force. But should the ticking of the watch equal in intensity the vibrations of the tuning-fork, the former could never approach the latter in musicalness.

The tuning-fork is a means of comparison between bone-conduction and aerial conduction of sound in the same person; for, if the vibrating tuning-fork be held on the vertex until its note is no longer perceived by the examined, and then held before his ear, if he now perceive that the

tuning-fork is still vibrating, it is fair to conclude that the sound-conducting apparatus is normal. But, if the fork, when no longer heard through the air beside the ear, be heard without being re-struck as soon as it touches the vertex, the conclusion is inevitable that there is some impediment in the sound-conducting part of the ear. This is all the more convincing if it be borne in mind that the same note is being used, and one, too, growing a little weaker all the time. For, if vibrations of a tuning-fork cease to be heard in front of an ear, by aerial conduction, but are able to communicate themselves, while growing constantly weaker, through the bones of the head, the inference of great derangement in the middle or external ear cannot be avoided. *Rinne's test* consists in applying the tuning-fork alternately to the ear and its mastoid process, under the above-named conditions.

Speech.—By hearing speech the intellectual development of the human being is accomplished. All aurists are aware that patients are constantly surprised to learn the amount of their deafness as soon as their faces are turned from the speaker. The failure in hearing in this respect is often first detected by the patient in the summer-time, when all are accustomed to sit on porches or in the parlor, in twilight and the dark. As the daylight fades and the faces of those around are no longer plainly visible, the hitherto apparently hearing person becomes aware that he is growing deaf. This is often assigned to the night air, but in reality it is due to the loss of vision in the darkness. The surgeon will often derive great aid from a knowledge of these facts, and also by observing how a partially deaf patient will look at the person speaking.

The human ear perceives, as music, tones varying from sixteen vibrations to twenty thousand vibrations in a second. Preyer has lately placed these limits from fifteen vibrations to forty thousand nine hundred and sixty vibrations in a second. Blake has shown that in some instances the human ear distinctly hears, as musical tones, from thirty-five thousand to forty thousand nine hundred and sixty vibrations in a second.

Speech, according to O. Wolf, embraces only eight octaves,—viz., R of sixteen vibrations, and S of four thousand three hundred and twenty-four vibrations in a second. It may be said, therefore, to lie entirely within the limits of music.

Acoustic Character of Vowels and Consonants.—The distance at which separate *vowels* can be heard has not yet been established, but they are endowed with the greatest strength of tone, being heard and understood at a distance at which all the consonants are inaudible.

Consonants.—Consonants may be classified, according to their acoustic and physiological laws, under two heads,—viz., those which are self-sounding and those which are sound-borrowing. The former are such as possess a sound entirely independent of association with a vowel sound, and one that can be defined respecting its pitch, intensity, and timbre. The latter are such as must be either preceded or followed by a vowel in

order to render them audible, and hence the name of sound-borrowing consonants has been applied to them by Wolf.

Helmholtz has also pointed out the very noticeable fact that if in calm weather an observer be placed on some elevation near a town,—a tower or a hill-top,—it will be found that words are no longer distinguishable, or at best only those composed of M and N with vowels. Vowels can be heard following one another in a curious mixture, and with remarkable cadences, because no consonants are heard, and the other vocal sounds cannot be joined into words.¹

It is thus shown that in the component sounds of speech a wide range of tests of different intensities and pitch is offered to the aurist. Such a numerous set of tests is needed in order to discover which sounds are heard best by an affected ear. One sound is not sufficient, because an ear may be unable to hear certain sounds, but be comparatively good for others. Hence, if only one or two sounds should be employed, as in the watch, just those sounds might not be heard as well as others. No sound-unit has ever been established, and, if it were, it would be useless, since, from the nature of the ear, such a unit would not be equally applicable in all cases. Therefore speech becomes valuable as a test because of its composite sound-nature, and also because it is ever at the command of the examiner, whose object in applying it as a test is comprehended by the patient without any preliminary instruction.

Whispering and Loud Tones.—Very often whispers and words spoken in low tones are heard much more distinctly by the affected ear than loudly spoken words. This is due to the damping of vowels, as shown by Wolf, whereby the consonants, which have been stated to be less sonorous than vowels, have a chance to be heard. This fact is of great importance, not only in estimating the hearing, but in addressing those hard of hearing. Members of a family very often pitch their voices too high, and hence confuse the afflicted one, thus gaining the idea that the individual is deafer than he really is. On the other hand, they are surprised that on some occasions he hears sounds and words spoken to others in comparatively low tones. Do not elevate the voice too high when you wish to make a deaf person hear, but do not lower it too much, unless to a whisper, if it is not desired that he should hear.

Whispering.—Whispering has an advantage over loud words in testing, since the former cannot be as easily conveyed as the latter through the bones of the head to the auditory nerve.

Variable Hearing.—The hearing varies very greatly in cases of movable fluid in the tympanic cavity and in some forms of aural vertigo. When such peculiarities of hearing are fully established, they may aid greatly in diagnosis. The first kind is made manifest by changes of position of the patient's head; the second form of variability of hearing comes and

¹ Tonempfindungen, etc., S. 118.

goes with the paroxysm of vertigo. It is probably due to alterations in the condition of the muscles in the tympanum, whereby altered tension in the sound-conducting apparatus is produced.

Hearing Low Tones better than High Ones.—It is sometimes observed by patients that they hear low, bass notes much better than high ones; as, for example, in two instances patients volunteered the information that they heard thunder much better than the chirping of crickets, and bass notes much better than high ones on the piano or organ. In testing with a watch, it was found that one giving out the deeper note was most easily heard by one of these patients; the other was not thus tested. Experimentally, I have shown that a deep note has the advantage of high notes in cases of increased labyrinthine pressure (page 45). In an increase of such pressure the stapes becomes more fixed, and it is on this small bone that the vibrations begin to grow less as the pressure within the labyrinth is increased. In such a case it is manifest that, if vibrations from without are normally conveyed to the stapes, they must there meet with hinderance in their endeavor to reach the labyrinth. Only the more powerful sound-waves are able to overcome this obstacle and force the stapes into to-and-fro motions with the rest of the chain of ossicles.

The position and extent of perforation in the membrana tympani may cause variation in the hearing-power for certain sounds, especially consonants, as shown by Wolf.¹ Experiments with the consonant B upon defective drum-heads show that the perceptive power for this sound diminishes as the extent of the defect increases. The faintness of the consonant is most observable when it stands at the end of the word. It may also be said that defects of the membrana flaccida are attended by great deafness for all sounds, which is probably due to an implication of the malleo-incudal joint.

Testing the Hearing in One-sided Deafness.—In measuring the hearing for sounds conveyed through the air in cases of one-sided deafness, or of hardness of hearing confined chiefly, if not entirely, to one ear, care must be taken not to attribute to the worse ear that which is really heard by the better ear, though stopped and turned from the examiner. In any case where one ear is being tested, accuracy would demand the isolation of the other. Usually, the ear not being tested is stopped and turned from the source of sound, the ear under examination being left open and turned towards the sound source. This method will usually give at least a proximate result as to the amount of hearing in the worse ear; but in order to exclude the fact that the better ear, though stopped and turned away, hears some of this test, it will be necessary to measure the hearing in the worse ear alternately open and stopped in order to see what effect this stoppage will have upon the amount of hearing it is supposed the worse ear still retains.

¹ Sprache und Ohr, second part.

Acoustic Railroad Signals.—At the time of entering the service locomotive engineers and stokers should have, at least on one side, normal hearing or nearly so. Every two to five years these operatives should be re-examined and their hearing distance tested with a continuous scale, to see whether the required signals are properly heard. Operatives in the service of railroads should be able to hear a whisper at a distance of at least one metre, or a yard.

Simulated Deafness.—Minute acquaintance with otologic diagnosis ranks above all other means for the detection of aural malingering.

Cutaneous diseases, organic defects, morbid growths, and injuries of the auricle enter so largely into the work of the dermatologist and the general surgeon, and so little into the work of the aurist, that they will not be considered in this treatise, excepting in so far as they affect the external auditory canal, impair the hearing, and are thus brought to the aurist's attention.

CHAPTER IX.

CIRCUMSCRIBED AND DIFFUSE INFLAMMATION OF THE EXTERNAL AUDITORY CANAL.

OTITIS EXTERNA CIRCUMSCRIPTA.

OTITIS EXTERNA CIRCUMSCRIPTA consists in a circumscribed inflammation of the skin or subcutaneous cellular and fibrous tissues of the auditory canal, terminating in a small abscess or boil, which, in discharging its contents, produces considerable destruction of the skin covering it. Its seat is not confined to any particular portion of the auditory canal, but as it is most likely to occur in a region rich in glands, it is apt to be found in the outer part of the meatus.

Symptoms.—This disease is usually extremely painful, and is attended by fever and even considerable cerebral symptoms in some cases. The boils usually occur one at a time, but the series may amount to a dozen. Sometimes they appear to merge so fast into one another that the ease gained by the discharge of one is hardly enjoyed by the victim until the throbbing and burning pain of a new one warns him that he must endure the torment of another. The auricle may become sensitive to the least touch and traction, especially if the abscesses are in the cartilaginous part of the canal, and the patient then cannot endure the ordinary pressure of the affected side of the head on the pillow. But such sensitiveness of the ear is not so likely to occur in this form of otitis externa as in the diffuse form. The severest pain and most distressing symptoms are found when the boil is seated in the unpliant parts of the bony portion of the canal; intense distress, however, may be caused by a boil seated just within the opening of the auditory canal. Usually the gravity of the pain and febrile symptoms will depend upon the depth of the abscess in the tissues of the auditory canal, as well as upon its proximity to the drum-head. Small superficial abscesses do occur in the meatus without any pain, a sense of discomfort and dulness of hearing having been the only cause of the patient's seeking surgical relief. But, of course, such cases are very rare, and are explained by the superficial seat of the inflammation. Hardness of hearing and deafness are prominent symptoms of furuncles in the auditory canal. In some cases the deafness is almost absolute, and the congestion being so great, and extending consecutively even into the cavity of the tympanum, the deafness is the last symptom to disappear. But the patient can be assured of the ultimate return of the hearing in such cases if there has been no organic lesion of the drum-cavity.

Inspection of the auditory canal and membrana tympani is usually very difficult if the disease is advanced and the swelling of the meatus considerable. This difficulty is less likely to occur when the disease is in the outer part of the cartilaginous portion of the auditory canal, for with care it may gradually be stretched by the speculum. When the abscess is in the inner portion of the cartilaginous canal, one can usually obtain a view of the drum-head only in the earlier stages of the disease. When the abscess in the deeper portion of the canal becomes fully developed, the view of the drum-head will be entirely cut off and the deafness and tinnitus become great. After the discharge has occurred the drum-head may be seen as a red and somewhat sodden membrane, which, however, in a few days gradually assumes its normal color and outline, and the hearing will be found to be returning.

Etiology.—Boils in the external auditory canal are always of artificial origin, being caused by the insertion of septic matter into a follicle of the skin in the act of rubbing or scratching of these parts by the patient.

Treatment.—The treatment of a boil in its immature stage should consist in the application of a pledget of cotton soaked in a mixture of black wash and glycerin (one part of the latter to seven of the former). This softens the inflamed tissues with an antiseptic dressing. The latter should be renewed every hour or two until maturation of the boil. As soon as the latter occurs the surgeon should mop away with a formalin solution (1 to 1000) all results of inflammation, and then mop the open mouth of the boil with ichthyol and water in equal parts. If some ichthyol can be forced into the abscess cavity it will be an advantage. Under this treatment I have rarely seen a second boil spring up in the ear, whereas the old method of septic poulticing was always followed by a crop of boils. Neither should a boil be incised, as the cut furnishes a furrow for the staphylococcus to grow in and produce more boils or even a diffuse otitis externa or dermatitis in the canal.

DIFFUSE OTITIS EXTERNA.

Diffuse otitis externa consists in a general dermatitis of the external auditory canal. It is characterized by redness, swelling, and sensitiveness of the entire external auditory canal, and in some cases by similar symptoms in the concha. In such a condition the patient cannot endure touching or moving the auricle.

Etiology.—The causes of diffuse otitis externa are various forms of irritants applied to the skin of the external auditory canal. These may come from within or without. Among the latter may be named exposure to cold air and cold water, traumatism of any kind, furunculosis of the external meatus, and the extension of skin diseases from the face and auricle to the auditory canal. The improper use of all kinds of ear-picks, aurilaves, hairpins, and toothpicks for fancied cleansing or for

scratching the ear-canal is constantly productive of diffuse external otitis.

Syphilitic Otitis Externa.—Soft chancres and mucous patches have been observed in the external auditory canal. I have seen in secondary syphilis, when an erythema was visible upon the forehead and face of the patient, a similar papular and furfuraceous condition of the auditory canal and membrana tympani. Under constitutional treatment the eruption disappeared simultaneously from all the affected parts. I have also seen in several instances cicatrices after ulceration of the canal and membrana tympani in adults who had been the subjects of hereditary syphilis.

The *diphtheritic* form of diffuse external otitis is very rare, being unmentioned by many authorities. According to the best observers, it is never a primary affection, but rather an occurrence in the later stages of an inflammatory process. This form of the disease is usually found in scrofulous subjects in whom the original inflammation has been either neglected or improperly treated. In all such cases, after the usual purulent discharge has lasted a longer or shorter time, there is a sudden increase of pain and fever, with the simultaneous appearance of a white diphtheritic membrane, which adheres most closely to the inflamed structure, and when even lightly touched causes intense pain and some bleeding of the parts beneath.

In children there is often found, at the termination of an attack of diphtheria, inflammation in the external ear. This rapidly extends, in some cases, directly to the bone of the canal and backward to the mastoid process. Pain is not a prominent symptom in these inflammations following diphtheria, and this fact will readily distinguish them from the truly diphtheritic form of external otitis in which the peculiar false membrane is found in the auditory canal. The form of the disease now referred to is one arising from the broken-down condition of the little patient rather than a form of disease already described as the diphtheritic. In the former case the pain is not great, the swelling is considerable, and the tendency to attack the bone is marked. Fluctuation is soon felt over the mastoid region, and after the evacuation of the pus the bone beneath is found denuded and in some cases crumbling. Exuberant granulations spring up around the opening made by the knife in the soft parts, and the peculiar depressed mouth of a sinus leading to dead bone soon begins to make its appearance. With a probe, a tract of bare bone corresponding to the region around the bony meatus may be detected. For weeks no portions of this diseased bone will come away, but at last the nearest edge of the dead tract will appear to rise up, so that a probe may be worked under it, and then gradually, day by day, the dead shell or scale of bone (for it is in many cases the outer wall of the mastoid cells) will be found to be coming out through the sinus. This process is attended by more or less discharge from the ear, but if the sinus behind the ear

is kept freely open, the discharge from the auditory canal will be very slight, and hence granulations are not usually found in the canal in such a case, for the drainage is kept up from behind and away from the auditory meatus. During this process the patient has no pain and the discharge is not very copious, but there will be, from time to time, swelling of the glands in front of and under the ear and down the tract of the sterno-cleido-mastoid muscle. These swellings are neither painful nor very hard. They last for a few days and then usually disappear, though they may suppurate in the worst cases.

In badly fed and delicate children the diphtheritic form of otitis externa may pass into the *gangrenous* variety. According to Gruber, otitis gangrenosa is much more likely to occur in children than in adults. Although the external otitis occurring in diphtheritic children may lead to necrosis in and about the tympanum, with exfoliation of large pieces of the posterior wall of the auditory canal, I have never seen such cases assume a truly gangrenous nature.

Diagnosis.—The prominent symptoms of otitis externa diffusa are the great pain and the high degree of hardness of hearing and tinnitus as the swelling in the canal increases. The motions of the jaw also cause great pain, and the patient is unwilling to chew hard substances on account of the tenderness of the ear. Inspection of the membrana is cut off by the swollen walls and consequent obstruction of the auditory canal.

Treatment.—If we are able to begin the treatment of diffuse inflammation of the external auditory canal in the early stages of congestion and pain, the first course to pursue will be to cleanse the auditory canal by syringing with carbolic acid and warm water (1 to 40), and then apply black wash on cotton. If the skin begins to secrete, as it may at more than one point, there should be applied to the canal equal parts of ichthyol and water either by gentle mopping or on cotton wicks kept in the canal for from twelve to twenty-four hours, when these dressings should be removed and fresh ones put in by the surgeon. There can be no successful antiseptic treatment of an acute ear disease of any kind by the patient or his friends at home. When discharge has been fully established, nothing will be found as efficient in checking it and in preventing the growth of granulations as insufflation of boric acid in fine powder, eucrophen, or nosophen.

If polypi should spring up with well-defined base or pedicle, they must be extracted by one of the various means described farther on, and their attachment to the canal thoroughly touched with a saturated solution of silver nitrate or a very minute quantity of chromic acid. In every case where polypi are pulled out the patient should be told before the extraction that it will be necessary to touch the base of the growth with the acid or some other caustic several times, perhaps, in order to effect a cure.

The treatment just described is that adapted to the ordinary form of

otitis externa diffusa with no worse complication than polypoid granulations or polypi; there are, however, several other forms of this disease, as already stated,—viz., the diphtheritic, the gangrenous, the syphilitic, and the parasitic.

The treatment will be modified in the first three by the fact that they are much more painful than the fourth, which, however, causes some pain. As the first three indicate a constitutional alteration and poisoning of the blood, their treatment must be largely of a supporting and alterative nature. Their names will indicate the kind of blood-poisoning they are due to, and their general treatment must be conducted on the principles followed in the same diseases when they manifest themselves elsewhere in the body.

Otomycosis.—The most common cause of this form of otitis externa diffusa is the growth in the auditory canal of that kind of fungus called *Aspergillus*. Its two chief varieties are *A. nigricans* and *A. glaucus*, or *flavescens*, the former of which is found in the ear much more frequently than the latter. The ascomycete, or the highest form of development of the aspergillus, is of very rare occurrence in the ear. Some writers allude to an *A. flavescens*, but this is probably only a darker-colored *A. glaucus*. Clinically, it would be much better to call the *A. nigricans* the *A. major*, and *A. glaucus* the *A. minor*, since the former is so much larger than the latter. This difference in size, as well as in other ways, is easily seen under the microscope. Macroscopically, there is no distinct and guiding difference in appearance between these two forms of the fungus. The microscope alone can decide which of the two forms we are dealing with in a diseased ear.

These forms are easily distinguished from each other by the shape of their fruit-heads and the arrangement of the sterigmata thereon, and on these differences I propose to base their nomenclature. So far as their color is concerned, it is wholly unreliable as a diagnostic difference; in no instance is it either clearly green or black. In all cases of ordinary aspergillus the color is yellowish or brownish. It has never been shown that one form excites an inflammation different from that produced by the other. For the sake of uniformity and order, I shall retain the names *A. nigricans* for the larger and *A. glaucus* for the smaller species.

Microscopic Features.—The microscopic features of the growth of this parasite in the human ear are varied and full of interest. If a small piece of a colony of *Aspergillus nigricans*, in the earliest stages of its development, be examined under the microscope with a power varying from two hundred and fifty to three hundred diameters, a field similar to that in Fig. 69 will be observed. It is, in fact, the first formation of rootlets or the mycelial web, from which, at a later period, the fruit-stalks or fructiferous hyphens spring. It will also be seen that some of the filaments composing the web tend to become bulbous at one end, and that

the latter, as the stem grows, becomes larger and dotted (Fig. 70), until finally there is standing out from the dense web of mycelial filaments a perfect fruit-stalk and a fructiferous head,—the latter studded with short, peg-like limbs, the sterigmata, on the free ends of which are the spores (Fig. 71, B). All of these stages of growth I have watched in specimens of the fungus removed from the human ear. In the fluid parts of the specimen epithelium may usually be seen in small quantities as the parasite develops, as in the upper part of Fig. 70.¹

Very rapidly—in the course of a day or two at most—the perfect fruit-stalk is formed in large numbers and in all stages of development, and the mycelial filaments can be seen to be coarser and septate. On one hand is a well-formed though unripe fruit-stalk and head (Fig. 71, B), while in the centre of the field there may be seen the ripe ærial fruit, from which the fully grown spores drop literally in myriads (Fig. 71, C).

FIG. 70.



FIG. 71.



The characteristic difference between the two varieties of aspergillus, the so-called *yellow* and *black*, is seen in the shape and size of the *receptaculum* and the arrangement of the *sterigmata* upon it, these two parts forming the so-called head or *sporangium*.

In the *A. nigricans* (Fig. 71, B) the sporangia or heads are distinguished from those of the *A. glaucus* (Fig. 71, A) by the fact that in the first the sterigmata cover the receptaculum, which is spherical, on all sides, while in the latter, the lower fifth or fourth of the receptaculum, which is ovoid in shape, is entirely free from sporangia.

Macroscopic Features.—The macroscopic appearances of a mass of this

¹ Figs. 69, 70, and 71 are from original drawings by the author.

fungus, as found in or washed from the ear, are worthy of attention. If an ear containing a mass of aspergillus be examined by means of an ear-mirror and ear-funnel, it will present most usually an appearance which leads to the supposition that the ear is occluded not by wax, but by a foreign matter of an organic nature.

If the fungus has been in the ear but a short time, merely a patch of pale yellow, pollen-like matter, of varying diameters, will be detected at the fundus of the auditory canal. This small colony of spores just developing into filaments is usually situate on the membrana tympani or very near it. In any case, whether or not the first deposition of spores occurs there, the tendency of the aspergillus is to grow over the drum-head first, and from that point it spreads outward, covering the wall of the meatus, until a hollow cast of the canal is formed by the vegetable parasite. The pollen-like appearance is seen only in the very earliest stages of the growth of that which finally becomes so-called lardaceous-looking false membrane, either partially or entirely filling the external auditory canal.

In some cases the fungous mass looks like a ball or plug of wet newspaper, and in others the ear may seem to be plugged with a substance looking like wool. An inexperienced eye might conclude that the occluding plug thus formed is of ear-wax; but ear-wax looks more solid, shining, and drier, and never excites pain and inflammation in the ear like the fungus aspergillus.

This false membrane is composed chiefly of mycelial net-work, with all forms of aërial fructification of the plant, and some epithelium from the auditory canal. The sporangia are usually found on the surface of the false membrane turned towards the wall of the auditory canal. Although the most perfect forms of growth of the fungus are usually found near the drum-membrane, I have seen specimens so flourishing at the mouth of the auditory canal that the latter appeared to be sprinkled with bright yellow pollen. In such a case the membrana tympani may not be seriously implicated. Usually, however, the membrana tympani and the skin of the canal near it are inflamed by the aspergillus.

An auditory canal which has been the seat of inflammation is most liable to be invaded by the aspergillus. It seems that the remnants of the inflammatory disease, such as pus, dried mucus, epithelial *débris*, or blood, form excellent soil for the growth of the parasite. An active discharge from the ear, however, is unfavorable to the growth of aspergillus in the canal. Aspergillus cannot remain in an auditory canal for any length of time without causing the characteristic symptoms of its presence.

Symptoms.—The symptoms of this disease are a sense of fulness, slight pain, burning, itching, tinnitus aurium, and hardness of hearing. The vessels of the malleus become congested, and in a day or two the membrana tympani is hidden by a thick, white, false membrane. The slight serous discharge which now sets in marks the detachment of the false membrane and the cessation of pain. In some cases the cutis of the

auditory canal is deeply inflamed, but not invariably. The pain may become intense if the parasite is not removed. Men are more frequently attacked than women. *Aspergillus* not only spreads from the drum-head to the wall of the auditory canal and *vice versa*, but it sometimes perforates the drum-head and finds its way into the drum-cavity.

Etiology.—Respecting the etiology, it may be stated that previous disease of the ear, especially when limited to the canal, and the use of septic domestic remedies for different aural diseases are the most fruitful causes of this malady.

Treatment.—The treatment of otomycosis of the fundus and walls of the external auditory canal, induced by the growth of *aspergillus*, consists first in removing the parasite, and, secondly, in destroying the germs and allaying the inflammation which their growth in the ear-canal has caused. The destruction of the parasite is most easily and efficiently accomplished by thoroughly covering the fundus of the canal and all other parts of the external ear affected by the growth of the fungus with powdered boric acid, borax, or boric acid in combination with chinoline salicylate (one of the latter to sixteen of the former). Thorough syringing on the part of the surgeon will accomplish the removal of all parts of the mycelial false membrane which may have become detached from the wall of the auditory canal. Those portions of the parasitic growth not spontaneously detached can generally be loosened or wiped from their seat by means of the gentle use of the cotton dossil on the cotton-holder, under thorough illumination of the affected parts by the forehead-mirror. The method of application of these, or any powders, to the affected ear is by insufflation, as represented on page 77. An ear affected with *aspergillus* should be seen every day by the surgeon, who alone should syringe it, and thus remove the loosened portions of the membrane. After the ear is thus cleansed, a fresh insufflation should be made of one of the powders named above. This is by far the quickest method of destroying *aspergillus* in the ear and of allaying the inflammation it has produced.

The substances named as useful powders doubtless owe their virtue to their antiseptic and germicide properties. I have found it useful, after all signs of the growth of the parasitic fungus and inflammation have disappeared, to allow the powder to remain a little while in the ear—it may remain there indefinitely without injury—in order thoroughly to sterilize the previously affected parts.

CHAPTER X.

FOREIGN BODIES IN THE EXTERNAL EAR.

ANIMATE as well as inanimate bodies are frequently found in the external ear. The former may become of great surgical importance from the annoyance, inflammation, pain, and deafness which they are very apt to produce, as well as from the fact that they may find their way into the middle ear.

The source of foreign bodies may be either from within or without. Under the first class may be placed : abnormal collections of ear-wax from the ceruminous glands ; masses of horny epithelial scales, forming the so-called *keratosis obturans* of Wreden ; and collections of stiff hairs from the tragus and auditory canal ; also clotted blood, inspissated aural discharges, scales of dead bone, and, in one sense, many of the new formations in the external ear. But, of these varieties of foreign bodies, only the first three will be considered here ; the remainder are discussed elsewhere.

Under the second head may be classed all animate or inanimate things small enough to have been placed in or gotten into the external ear from without.

The manner in which they may get into the ear is extremely varied. Foreign bodies of this class are most frequently found in the ears of children, where they are placed, usually in play, by the victim or his companions ; or foreign substances may be thrust into the ears of adults and of children by accidental or intentional violence. Animate bodies fly or crawl into the ear of man.

FOREIGN BODIES ORIGINATING IN THE EAR.

Collections of Cerumen in the Ear.—The appearances of an impacted plug of cerumen in the external auditory canal are not very varied. Usually it is easily recognized, but now and then, especially when the impacted mass is due to slow accretion by the daily pushing in and smoothing down of its layers by the towel or fingers of the patient, it will not be easy for the unpractised eye to recognize the mass at once as one of cerumen, for in some cases the impaction has so completely adapted itself to the fundus of the meatus and the drum-head as to resemble a dark and polished *membrana tympani*. In many cases such a polished mass of cerumen has been regarded as a somewhat abnormally colored drum-head, and treated as such, the deafness dependent upon the impaction of the wax being attributed to other causes and in some way

connected with the "discolored membrana tympani." Such failures in diagnosis lead to curious results.

It is, indeed, not uncommon to find patients suffering from impaction of cerumen in the auditory canal being treated for some other aural disease with which they are not affected. Thus, the Eustachian catheter and instillation of silver nitrate have been applied to relieve the deafness which a proper syringing would have speedily cured.

When the onset of hardness of hearing in cases of impacted cerumen is rapid, it will usually be found that the mass has been suddenly washed in upon the drum-head in bathing.

When the deafness due to impacted cerumen has been coming on slowly for months, sometimes for years, it will usually be found that the patient has been addicted to the very bad habit of swabbing out his ears, most commonly with the rolled-up corner of a towel, and sometimes with that most pernicious and reprehensible implement, a piece of sponge fastened to a stick, and sold by druggists under the high-sounding name of an "aurilave." In these cases the plug will be found well packed in and moulded to the fundus of the auditory canal and drum-head.

Such masses are not very hard to remove, considering the long period of their accumulation; they are usually found to contain large quantities of short fibres of cotton or linen from the towel used in the efforts to cleanse the ear.

Impaction of cerumen by attempts at cleansing the meatus not only occurs among adults, but is found among children, whose over-anxious attendants are constantly swabbing out the meatuses of their charges with a corner of a towel or by other means. Such treatment sometimes results in a chronic ulcer of the bony portion of the auditory canal, or in the growth of a large polypus from an ulcerated spot on the wall of the bony canal very near the drum-head.

In these cases of artificially impacted epidermis and cerumen the foreign mass usually assumes the form of a hollow cast of the auditory canal, or a glove-finger, with a cast of the drum-head on the tip. Such cases are usually stubborn, and in some instances the integrity of the bony structure of the auditory canal is threatened.

Reflex Effect of Cerumen Plugs.—Ear-cough, vertigo, and nausea, in addition to deafness, may be produced by wax plugs in the ear. Even a melancholic form of dysthymia may be caused by such mechanical irritation in the external ear of nervous patients.

Treatment.—The treatment of simple impaction of wax in the ear consists in the use of the syringe, as already explained (pages 81, 82).

Laminated Epithelial Plug in the External Auditory Canal.—This obstructive disease of the external ear was first described by Wreden,¹ of St. Petersburg, and named by him *keratosis obturans*, in contradistinction to

¹ Archives of Oph. and Otol., 1874.

ceruminosis obturans, the impacted plug of ear-wax, with which it has often been confounded, though differing from it very widely. The latter, as its name implies, consists of a mass of inspissated cerumen, but it is easily removed by proper syringing, and the ceruminous nature of the mass removed from the ear is recognized, among other features, by the rapidity with which it dissolves in water.

Keratosis obturans, however, justly described as a separate and special disease of the ear, is a collection of epithelial laminae, derived from the cutis of the external auditory canal, of gradual accretion, causing great deafness, and very obstinate in its resistance to removal. Beneath these masses, in a typical case, the membrana tympani will be found normal in appearance and usually unimpaired in function, but the skin of the walls of the auditory canal will be found ulcerated beneath such collections of epithelium. The hearing, as a rule, is good after the removal of the mass of epithelium from the canal.

These obstructive bodies are not confined to any age or sex. Upon inspection of an ear containing such a mass as has been described, a thin layer of ordinary cerumen may be seen covering the outer surface of the plug, and hence the impression is often arrived at that the case is one of ordinary ceruminous impaction; but continued syringing, by its barren results, soon convinces the operator that he has encountered no such ordinary obstruction.

The chronic inflammation and desquamation in the skin of the auditory canal usually found in these cases may have been set up and favored by the undue efforts at cleansing by the use of a swab, which, unfortunately, some individuals expend upon themselves and upon those under their care. Excoriation is first brought about, and then a slow exfoliation of dermoid cells goes on, and these are packed in and mechanically retained in the canal. As the mass of hard epidermis increases in size, it presses on the skin of the canal and tends to increase the local irritation. So great is the pressure and so sensitive is the inflamed skin in many cases of this desquamative affection of the ear that the presence of these laminated plugs is often attended by great and constant neuralgia in the auditory canal, in front of and behind the auricle, and even over the temple. These plugs are so hard that they retain any discharge which may emanate from the inflamed surface. In this way they further tend to keep up irritation and pain and to complicate the disease.

Treatment.—In cases showing a decided tendency to recurrence or renewal of these masses in the ear, care in preventing an accumulation of the horny laminae, by close watching and speedy removal of the slightest amount of scales, will greatly simplify the disease and the treatment.

A solution of soda in water (ten grains to the fluidounce) is the simplest and best loosener of the plug from the wall of the canal, but sooner or later recourse must be had to forceps and blunt probes. This

disease seems to furnish the exception to the rule of treatment, never to use anything more forcible than the stream from the syringe for the removal of foreign bodies from the ear. *Of course, the greatest care must be observed in the use of such instruments, and no one but the most experienced surgeon is justified in attempting to remove such a mass by instrumental means.* Perfect illumination of the meatus by means of the forehead-mirror or electric lamp, proper instruments, and cautious movements, added to a thorough knowledge of the use of the implements and the part to be operated on, must insure success.

The forceps represented in Fig. 60 (same size as original) is made to open and close very gently, and, being slender, cannot take a very firm hold upon the impacted mass of keratosis, but it is strong enough to pick off and lift away portions of the obstruction.

I fully agree with those who earnestly deprecate the use of any other instrument than a syringe for the removal of foreign bodies from the ear. The forceps, or any other instrument for removing objects from the ear, must never be tried until all other means have proved of no avail, and then only in the hands of the most experienced and under the most perfect illumination; for any manipulation of the ear resembling a blind grappling after the foreign body will most surely prove disastrous. Unfortunately, the proper occasion for the use of the forceps is almost invariably in an emergency, and is performed by the most inexperienced hands. Moreover, an examination into the facts of the case in which they must finally be used will usually reveal that originally they were not needed, and that the simplest syringing at the outset would have rendered the use of any other instrument unnecessary.

The only justifiable use of forceps at the outset may be in a case of keratosis obturans, but even in such cases all instruments must be used with the greatest caution in conjunction with repeated and thorough syringing. The accidents happening to the ear from the ignorant *use of instruments* for the removal of foreign bodies have been very numerous.

Seborrhœa of the External Auditory Canal.—This cutaneous disease is sometimes found in the auditory canal. It usually affects both ears at the same time, and women are more apt to be the subjects of the disease than men. The patients complain of having felt some pain or itching in the ear or ears, which has led them to make various applications to the affected parts and to scratch the ears with some implement, such as a pin. This may lead to inflammation and great pain. They generally find, sooner or later, that their ears are full of inspissated matter, in crust-like pieces, which they consider dead skin. In consequence of this accumulation there are more or less hardness of hearing and tinnitus aurium. It is for these last-named symptoms that they seek relief. Upon inspection, the surgeon finds the auditory canal filled with grayish-white, thick scales, more or less united into a pellicle, clinging to the wall of the

canal and extending over the membrana tympani. The caliber of the canal may not be entirely filled with this mass, but the drum-head is covered by it. This obstructive matter can generally be removed by forceps, and, owing to its tough coherence, it may be got from the ear in a rough cast of the canal and the drum-membrane. The hollow of this cast is dry, but the surface, which has been lying against the cutaneous lining of the osseous part of the canal, will be humid. This humidity is not due to pus, but rather to a semi-fluid sebum. The wall of the canal against which the seborrhœic mass has been lying is found to be red, tumid, and sensitive to the touch, and sometimes granulations, or even polypoid exuberances of the latter, are present. This disease is very frequently mistaken for eczema, but eczema rarely attacks the canal. If eczema is found in the canal, it will be seen that the auricle is also eczematous. In the disease under consideration, however, the auricle is entirely unaffected. These seborrhœic masses form very rapidly—often in the space of a week—after the disease is fully developed.

Treatment.—The seborrhœic masses must be carefully removed and the tumid and diseased surface of the skin of the canal treated. At the same time the general health, which is often found depraved, must be invigorated. The administration of Fowler's solution will greatly facilitate the cure of the skin disease in the ear. The local treatment should consist in the application to the diseased skin of an ointment containing ammoniated mercury gr. x to vaseline ℥i, or hydrarg. ox. rubri gr. x to vaseline ℥i. This may be put into the ear by the surgeon by means of a cotton dossil on the cotton-holder. Insufflations of boric acid will be of use in this disease, applied by the surgeon from time to time, after the inspissated crusts have been removed and the diseased surface fully exposed. This treatment must be kept up for several months in some cases before the cure is effected. The prognosis is always favorable.

Ingrowing Hairs from the Tragus resting on the Membrana Tympani.—Sometimes, though rarely, the growth of hair on the tragus may be so exuberant as to block up the external meatus or pass into the canal and rest upon the drum-head. In some instances the entire auricle, especially at the helix and tragus, may be the seat of excessive and almost ludicrous pubescence. In such cases of excessive quantity of hair near the auditory canal, loose hairs may get into the auditory passage, or masses of them block it up so as to induce hardness of hearing.

The symptom of single hairs on the drum-head will be a scraping sound heard only by the patient whenever the jaws are moved. If cerumen aid in the matting of the hair about the external meatus, considerable deafness may be the result.

Treatment.—If the hairs have led to obstruction in the canal, the foreign mass must be removed on general principles. Solitary hairs resting upon the membrana tympani may be lifted away by the slender forceps (Fig. 60) under illumination by the forehead-mirror.

FOREIGN BODIES FROM WITHOUT.

Inanimate Objects.—From time immemorial children have pretended to be able to place various kinds of seeds, beads, etc., in one ear and bring them out at the other, for the amusement of themselves or their younger and more ignorant companions. Children are very fond of stroking their faces with beads or any similar object having a polished surface. It is while thus amusing themselves, by stroking their ears, that beads, etc., often slip into the auditory canal. The variety of such bodies found in the ear is endless, consisting of wads of paper, all kinds of seeds and small beans, beads, round tips of pencils and penholders, pieces of slate-pencil, little stones, buttons, etc. Usually the foreign body is placed in the ear by the victim; sometimes it is pushed in there slyly by his playmates. Sometimes during quarrels various long objects, such as straws, pencils, penholders, bodkins, etc., are thrust into the ear maliciously, both among children and adults.

Foreign bodies often remain some time in the ears of children without doing harm. If a foreign body is found by chance in the ear of an adult, it may be learned upon inquiry that it was put there during childhood.

Irritant Fluids.—Melted lead, boiling oil, and other scalding fluids are sometimes poured into the external ear in malice or in ignorant endeavors at curing partial deafness. It is needless to say that all such procedures are not only painful but very dangerous to life. The resultant cicatrization in the auditory canal at least causes permanent deafness.

Improper Attempts at Removal of Foreign Bodies.—Much injury is often done by laymen as well as inexperienced physicians in their endeavors to extract foreign bodies from the ear.

Animate Objects in the Ear.—Usually, insects which are found in the ear have crawled or flown in during the sleeping hours of the patient. Of course this is most likely to happen to those who sleep upon floors or on the ground. Dead flies are sometimes syringed from the ears of children afflicted with otorrhœa, to which they are attracted by the odor of the discharge, but in most instances produce no pain or subsequent trouble by their presence in the ear. In some instances, however, maggots grow in the ear after it has been invaded by flies.

Treatment; Removal of Inanimate Foreign Bodies from the Ear.—When a foreign body is said to be in the ear, the surgeon should first satisfy himself that such is really the case before he begins any operation for its removal. Grave errors have occurred from the neglect of the surgeon to assure himself on this point. When it is fully decided that the statement of the patient or his friends is correct, and that a foreign substance is really lodged in the ear, if the latter has not become irritated and swollen by the attempts of others to remove such foreign substance, *usually a gentle syringing*, the patient's head being inclined towards the affected side that gravity may aid the surgeon's efforts, will bring away

the foreign body. In order to carry this out in very young children, already alarmed by the accidental entrance of the foreign body, we may

FIG. 72.

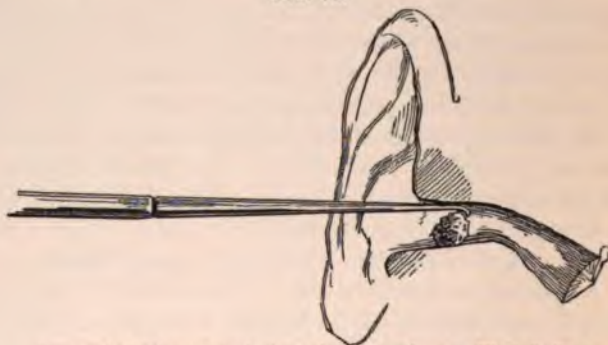


have to resort to etherizing the patient. In any case, when syringing will not remove the foreign substance and the ear is at all inflamed and swollen, nothing more forcible than syringing should be attempted until the local irritation is allayed. Too often the attempts at removal of a foreign body from the ear are far more injurious than its presence in the ear. It may be said that all insoluble substances will do no harm to the ear if let alone. They should be removed in order to prevent mechanical obstruction and deafness, but there is no need of haste.

If syringing with warm water will not remove a foreign body from the ear, other means should be applied only by an expert.

Removal by Small Hook.—Next to the use of the syringe in simplicity and safety in the removal of a foreign body from the ear is a small hook (Fig. 72). Under good illumination of the external ear, for there must be no groping in the dark, this

FIG. 73.



Removal of a foreign body from the external ear. (W. B. Dalby.)

hook may be inserted behind the foreign object, as in Fig. 73, and the substance gently drawn to the external meatus.

For the removal of impacted foreign bodies, either organic or inorganic, the late Samuel Sexton, of New York, devised the instrument represented in Fig. 74. Needle points have been substituted for the teeth of the bullet-forceps, being set at such an angle that when closed against a presenting surface of whatever shape they seize it by the approximation of the two blades in the handle. This is done by pressure of them between the thumb and forefinger, which forces the sliding ring over the blades which are armed with the needle-point teeth. The latter sink into any substance of an organic nature, taking a profound hold on it and permitting great traction.

Removal of foreign bodies from the ear by incision through the cartilaginous canal from without and behind the auricle was proposed by Paul, of Ægina. The usual mode of procedure is to make an incision above and behind the auricle in the mastoid region, down to the bone, and lay the auricle and cartilaginous canal forward towards the cheek until the insertion of the cartilaginous with the osseous canal is reached and plainly laid open to view. The posterior attachment of the cartilage to the bone is then cut through above and behind and the foreign body grasped by delicate forceps. Great care must be taken not to sever the cartilage entirely from the bone.

Removal of Animate Objects from the Ear.—Insects in the ear may be killed with a few drops of sweet oil and then removed by syringing. If maggots gain a hold in the ear, they may be killed by instilling a few drops of ether or chloroform into the external ear. After they are thus killed they may be removed by syringing or by means of a hook (Fig. 72) or forceps (Fig. 74) under proper illumination by a forehead-mirror or an electric head-lamp.

FIG. 74.



Sexton's foreign-body forceps; two-thirds natural size.

CHAPTER XI.

RESULTS OF INFLAMMATION AND INJURIES OF THE EXTERNAL AUDITORY CANAL.

Ear of the New-Born Child.—If the external ear and auditory canal of the new-born child is let alone, no inflammation will occur in it from retention of natural secretions. These will be removed by the natural outward growth of the skin of the external auditory canal. Unfortunately, the new-born child is very often the victim of swabbing and washing of its auditory meatus and canal. These manipulations often induce infection and inflammation of the skin in the ear, and in many cases lead to perforation of the membrana and to otitis media, with subsequent permanent deafness.

Abscesses in the external auditory canal sometimes evacuate their contents through the duct of Steno, or through the clefts found in the anterior part of the cartilage of the auditory canal.

Caries of the meatus may follow inflammation of the external ear. I removed, not long ago, an annular sequestrum from the auditory canal of a lady who had long suffered from otorrhœa. The sequestrum acted like an irritating foreign body, and its removal was followed by recovery.

Fracture of the Tympanic Bone.—The tympanic bone, which enters largely into the formation of the posterior boundary of the glenoid cavity, as well as into the formation of the anterior wall of the osseous auditory canal, may be fractured by falls or blows upon the chin or upon the cheek. The hemorrhage from the ear which usually occurs in these cases has at the outset often misled the surgeon into diagnosing fracture of the base of the skull. This mistake is all the more likely to be made if the patient is unconscious when first seen. Very often, however, the patient is not unconscious, but complains of pain in his ear, especially upon moving his jaw. The latter symptom, together with the swollen meatus and the detection of a projection of bone from the anterior wall of the canal into the caliber of the latter, will enable the surgeon to make the diagnosis of fracture of the tympanic plate. These fractures of the tympanic bone are usually compound, and hence semi-detached parts of the skin of the auditory canal may be seen projecting into the canal.

Treatment.—Excessive hemorrhage should be checked in a way not injurious to the drum-membrane. Hence cold water should not be syringed into the ear. Any portion of bone projecting into the canal, against or through the drum-membrane, should be carefully pushed back to its place or, if loose, removed from the ear. Healing should be con-

ducted so as not to permit encroachment upon the caliber of the canal. This can be effected by the judicious use of bougies or tents in the canal until healing has taken place.

Bleeding from the Meatus.—Hemorrhage from the ear occurs not uncommonly from traumatic causes which apparently produce no further lesion. A physician informed me recently that, slipping suddenly, he struck his mastoid process violently on a projection of some kind in his office. The blow was followed by hemorrhage from the meatus, but by no further trouble. The hemorrhage in such cases comes from a fissure in the skin of the external auditory canal, in its osseous portion. Hemorrhage from the meatus, connected with injuries to deeper parts of the ear, will be considered farther on, when alluding to injuries of the internal ear.

Treatment.—If the bleeding is due to an injury limited to the skin of the external canal, a mild styptic may be required. In any event the blood must not be allowed to form permanent clots or crusts in the meatus.

Vicarious Menstruation from the Auditory Canal.—Bleeding from the ear has been observed in some instances of suppressed menstruation. It may be preceded by pain and a sense of fulness in the ear, which, however, is relieved by the hemorrhage. It may occur from a sebaceous tumor in the meatus, or from the mucous membrane of the middle ear.

Epileptiform Symptoms from Irritation in the Auditory Canal.—It is well known that irritation set up in the auditory canal by the presence of a foreign body will produce epileptiform and even paralytic symptoms.

Ear-cough.—Ear-cough, a peculiar reflex cough excited by irritation of the external auditory canal, was known to medical men a long time ago.

Ear-cough is due to the fact that irritation of the auricular branch of the pneumogastric nerve, distributed to the auditory canal, is reflected to the motor fibres of the superior laryngeal nerve, also a branch of the pneumogastric. This induces contraction of the crico-thyroid muscle, which manifests itself in coughing and, in some instances, vomiting. Sometimes otitis externa diffusa will likewise produce the most distressing ear-cough, as will also hardened masses of cerumen in the ear-canal.

Chronic Circumscribed Ulceration of the External Auditory Canal.—Chronic diffuse inflammation of the external auditory canal sometimes ends in the formation of distinct and circumscribed ulceration at one spot in the passage-way. From this diseased point an inflammatory process may be communicated to the tympanic cavity, and hence ulceration of the external auditory canal becomes of importance. The ulcers especially alluded to here are found in the unyielding skin of the bony portion of the auditory canal, and by their general features of chronicity and sluggishness remind one of the ordinary leg ulcer. They throw off a

scanty dark gray or greenish discharge, somewhat offensive, and showing a tendency to form a dark crust around the mouth of the canal.

Sometimes the discharge seems to have ceased, but in a few days it returns again, and, if allowed to run on, the disease will tend to form polypi and to attack the drum-head. The latter becomes congested, all its normal features are lost, and upon syringing the ear, water may pass into the nose and throat. Up to this time the hearing may not be much impaired, for the middle ear has remained intact. Upon the occurrence of the perforation, however, the hearing is endangered.

In any case, therefore, where there is found a discharge from the ear with an intact membrana tympani, the most careful search should be made for the cause, and, if an ulcer is found in the bony portion of the external auditory canal, to it the treatment should be directed. These ulcers, if situated in or near the membrana flaccida, may communicate with the upper part of the tympanic cavity.

Etiology.—The causes of this disease are often obscure; but it will generally be found that a neglected inflammation in the canal has run at last into the chronic affection here described.

Treatment.—The treatment should consist in removal of any irritant which keeps up the ulcer, and in stimulation of the inflamed spot. The latter is best accomplished by cauterization with strong solutions of silver nitrate, conveyed to the ulcer by means of cotton on the cotton-holder. Insufflations of boric acid, borax, borated chinoline, or borated resorcin will be found of great service in this affection. All discharges are to be most carefully cleaned out by mopping with absorbent cotton, and the general health of the patient examined into and built up if necessary. As scrofulous children are liable to be the subjects of this kind of local disease in the ear, iron and cod-liver oil will play a most important part in the treatment of these ulcerations, when occurring in such subjects. The applications of the above local remedies should be effected by the surgeon daily at the outset. The patient's ear should be let alone at home, unless it runs greatly, when it may be mopped out with absorbent cotton. The hearing is not usually affected in the early stages, but it will be, unless the disease is arrested. The prognosis is favorable if the ear is attended to in time.

Reflex Ulceration of the External Auditory Canal.—Reflex neuralgia in the ear, from the irritation of diseased teeth and gums, has been alluded to and explained by the nervous connection existing between the mouth and the ear. We may go a step farther and explain reflex tissue-changes in the ear as induced in the same way. Ulceration in the anterior wall of the auditory canal, near the membrana tympani, may be reflex in origin. Such ulceration may be due to decayed molar teeth in the inferior or superior maxilla on the same side. At the outset there is usually some pain in the ear for a day, then a discharge is observed, the pain having ceased. Examination may reveal a well-marked ulcer-

ated spot on the wall of the auditory canal. This is usually made to heal in a short time, but in the course of a few days, or perhaps weeks, the same kind of an attack is again felt. In a case like this, a quick and permanent cure was effected after the removal of several diseased molars in the lower jaw of the same side. Such reflex tissue-changes in the auditory canal are evoked in the following way. Let it first be borne in mind that irritation proceeding from any part of the body may excite waves of blood-vessel-dilatation in a correlated area. In the disease under consideration the seat of irritation is in the teeth and gums and the correlated area is the external auditory canal. The blood supply to the external auditory canal is derived from the external carotid artery, by its branch, the posterior auricular, and the vasomotor nerve controlling the caliber of these vessels is derived from the external carotid plexus of the sympathetic. The diseased teeth in the case alluded to were supplied by the inferior dental nerve. Now, the large sensory division of the inferior maxillary nerve, from which the inferior dental nerve comes, is connected on its inner side with the *otic ganglion*. This ganglion is connected with the plexus of the sympathetic, controlling the external carotid artery. As branches of this artery supply the external auditory canal, it is easily seen how this part of the ear becomes an area correlated to the seat of irritation in the diseased teeth, through the medium of the otic ganglion. Since the result of irritation at one point in a vasomotor tract is to suspend the inhibitory power of vasomotor nerves in a correlated area, the vasomotor branches of the carotid plexus, regulating the supply of blood in the external ear, lose, for the time, their power of controlling the caliber of these vessels, on account of the irritation conveyed to them from the teeth through the otic ganglion. Therefore, the vessels in the external auditory canal become distended, and congestion, pain, and inflammation are the result. Treatment consists in placing the teeth and gums in a healthy state, and the ear can then be cured permanently.

Cholesteatomatous and Epithelial Impactions in the Auditory Canal.—These cholesteatomatous and epithelial masses are usually found in ears which have been the seat of chronic suppuration, but in which the latter process has apparently run its course. In such cases the mucous membrane of the middle ear, as well as the cutaneous lining of the external auditory canal, seems to retain a tendency to the exfoliation of large masses of epithelial scales, which, accumulating in the ear, undergo a fatty degeneration and give rise to various symptoms, among which the more prominent are pain at times in the ear (but this is not a prominent characteristic of these formations), nausea and dizziness, with occasional vomiting. The hearing is, of course, impaired by the mechanical hindrance offered by these masses, which may be so large as to cause absorption of the bone of the auditory canal and a consequent widening of this passage. Even greater irritation than this may ensue as a consequence

of the presence of such collections in the ear, and the bone structures on which they press may become carious. The soft tissues thus pressed upon ulcerate and in some instances become covered with granulations, and the membrana tympani and ossicles having undergone erosion, the entire tympanic cavity is occupied by the cholesteatomatous layers. The microscope reveals flattened epithelial cells and crystals of cholestearin as the components of these lamellated masses. This process is very analogous to that which produces keratosis obturans (page 104).

Treatment.—The treatment of such accumulations should consist first in the complete removal of the obstructive mass. This may require some patience, for the removal of the more external layers often reveals the presence of deeper and fresher ones, and in some cases new ones seem to form during the treatment. The latter tendency is best combated by the local application of an alterative astringent, as solutions of silver nitrate, copper sulphate, and zinc sulphate. I have found insufflations of boric acid and chinoline salicylate (page 103) to cure these cases promptly. The softening and removal of these masses is hastened by the use of solutions of sodium bicarbonate in glycerin and water.

Sebaceous Tumors, or Wens, in the Auditory Canal.—Sebaceous tumors, or wens, are sometimes found in the skin of the cartilaginous part of the external auditory canal.

Treatment.—A wen in the auditory canal should be promptly incised, its contents evacuated, and the cavity healed from the bottom.

Hyperostosis of the Auditory Canal.—In some instances there is found a general hyperostosis of the auditory canal, though most usually the hyperostosis is confined to its posterior wall. It is most likely to occur in those who have been subjects of chronic otorrhœa, or who have been exposed to the frequent entrance of cold water into their ears in bathing and diving.

This condition of hyperostosis demands no treatment unless it encroaches upon the caliber of the canal and impairs the hearing. Its treatment will be considered farther on.

Exostoses of the Auditory Canal.—Exostoses, or bony growths of a rounded, hillock-like shape, or pedicellate, are found in the external auditory canal. They are covered by the skin of the canal, are entirely painless, and the only annoyance they give is due to their encroachment upon the caliber of the canal. Their size varies from that of a merely distinguishable elevation on the wall of the canal to one large enough to occlude it and produce deafness. The skin covering them is a little paler than that of the canal.

Etiology.—These osseous growths may be congenital, or they may be the result of chronic inflammatory processes in the middle and external ear. They are frequently found in persons who have been afflicted for a long time with discharges from the ear, though they are also very often present in those whose ears are otherwise normal.

Treatment.—Exostoses in the external auditory canal demand no treatment, unless they occlude the canal and cause deafness by this obstruction. Then they may be bored through or cut away, as has been suggested and performed by several operators.

Other forms of acquired obstruction in the external auditory canal may be partial or total, and may consist of cutaneous bands, diaphragms of skin or bone, and horny growths.

Cutaneous Closure of the Auditory Canal.—Cutaneous closure of the canal at any point appears to be more frequent than bony closure. It may be congenital or acquired. This kind of obstruction in the canal is not always recognized at once, especially if the diaphragm of skin is stretched across the canal near the fundus; in such a position the obstruction may so closely resemble a thickened drum-head as to lead to some confusion in diagnosis.

In some cases polypoid growths, invading the same transverse plane of the auditory canal, may grow together, and, skin forming over them, a diaphragm is formed which stubbornly occludes the canal at that point. Beyond the diaphragm the passage may be normal.

Sometimes an orifice is found in the centre of this diaphragm, and by dilatation of this the diaphragm may be reduced to a simple constriction, and then the latter carefully widened.

Partial osseous closure of the canal occurs as the result of chronic purulent discharge from the ear, or from an osteitis set up by improper treatment, or other traumatic causes. In these the narrowing may be so great as to allow only very fluid discharges to escape, while retaining the more inspissated portions of pus.

Neoplastic Diaphragm.—These may be destroyed by the cautious application of chromic acid to the central portions. Such formations may be incised, and the edges of the cut treated antiseptically until cicatrization of the cut edges takes place.

Incise a diaphragm rather than excise it, and then dilate the incision with a drainage-tube of lead-foil, and keep the canal clean by antiseptics until cicatrization of the cut surface takes place.

Congenital Atresia.—The hearing may be very good in such cases. If so, an operation to create a pervious canal would be justifiable.

Acquired Atresia and Stricture of the Auditory Canal, and its Treatment.—H. Schwartze¹ gives as the usually accepted causes of acquired atresia of the auditory canal chronic purulent otorrhœa, especially that following scarlet fever, wounds, burns, and lupous, diphtheritic, and syphilitic ulcerations. To these he adds a new cause, arising during the last ten years,—viz., *unskilful operations on the mastoid process*. In the latter instance the atresia is the result of laceration of the posterior wall of the cutaneous canal by a spicula of bone or by the form of the operation.

¹ Archiv f. Ohrenh., Bd. xlvii. S. 71, and Bd. xlviii. Ss. 98, 261.

If in the subsequent treatment of the case this injury to the auditory canal is disregarded, and the granulations at the point of injury not held in check by tampons and cauterizations, a stricture will occur. If the opposite wall of the canal has been injured and granulations have formed there, the two granulation surfaces approximate and adhere, and a cicatricial atresia is formed.

For the relief of the atresia or stricture of the auditory canal, Schwartze has devised an operation consisting of the following steps. The usual incision is made behind the auricle as for a radical mastoid operation, and the auricle and fibro-cutaneous auditory canal detached from the posterior wall of the bony canal until the stricture is reached. The latter is then cut out of the canal and its lumen once more opened. If hyperostosis of the canal at or beyond the stricture is present it is chiselled away, and the membrana or its remnant and the middle ear and its contents inspected. The latter region is treated as in the radical Stacke operation if the condition of the middle-ear cavities demands it, the posterior wall of the bony auditory canal being chiselled away, the fibro-cutaneous auditory canal split longitudinally or horizontally, and the upper and lower flaps thus formed at that point sutured into the opening previously made in the posterior bony wall. The upper flap of the cutaneous wall is sutured to the upper angle of the posterior auricular wound and the lower flap to the lower angle of the mastoid wound, and a retro-auricular opening thus made for future treatment of the newly made external auditory canal cavity.

In some instances the posterior wall of the cutaneous canal is simply split horizontally, the flaps pushed into the mastoid wound and sutured there, after which the retro-auricular wound is united by primary suture.

In the eleven cases operated upon, the operation (detachment of the auricle and cutaneous canal and excision of the stricture or atresia regions) was in nine cases united to the radical operation of opening all the middle-ear cavities, and in only two instances was there no such bone operation. The result in these two cases of recurrent narrowing of the reinstated lumen of the canal raises the question whether it is not advisable, even in those cases in which an isolated cicatricial closure of the canal occurs, and when the nature of the disease of the parts beyond the stricture does not demand an operation on the mastoid bone, to make it a rule to widen the auditory canal by the concentric removal of flat layers of bone from its posterior wall. In any event, a study of the table of cases presented by Schwartze shows that in them permanent cure of the stricture of the canal was obtained only in those cases in which the stricture operation was associated with the radical bone operation, usually without the permanent retro-auricular opening.

When we consider the fact that in most cases this operation revealed caries behind the stricture, the latter being of long standing, it is surprising that in such cases intracranial complications from retention of

pus have not more frequently arisen. The stricture operation resulted in curing the chronic suppuration in seven of the eleven cases, in one instance the result is unknown, and in two cases the suppuration still continued. The stricture (or atresia) was cured in seven cases, in one there was a relapse, and in three cases there was a partial return of the stricture. Schwartze asserts that the stricture and atresia operation he has recently proposed is a decided improvement over the old methods of operating on the stricture through the external auditory meatus. However, as he points out, there exists at the point of the stricture a tendency to the formation of new bone, favoring a renewal sooner or later of the stricture, and depending upon causes unknown at present. Perhaps this persistent tendency to hypertrophy of the bone is the result of a chronic irritation of the skin and bone, brought about by the stagnation of secretions confined behind the stricture. However, if the operation cures the suppuration behind the stricture, life is not endangered by a recurrence of atresia of the canal. The better results of the new stricture operation force us to conclude that it should in all cases be preferred to the old method of operating through the external meatus.

Epithelial Cancer of the Auditory Canal.—Epithelial cancer may attack the tissues in the meatus after first appearing at or near the tragus. The growth at this point may rapidly ulcerate and advance inward along the canal, with great pain in the ear. The wall of the meatus becomes covered with small, wart-like excrescences, the tissues in the canal become infiltrated and disorganized, and the membrana tympani is invaded and perforated. Fistulæ may appear between the mastoid and auricle, resulting in the destruction of the canal, and in its place a large opening may be made by the disease. The articulation of the jaw now becomes exposed, the lymph-glands in the neighborhood infiltrated, and facial paralysis, with exophthalmos and blindness in the eye on the affected side, ensues. Death occurs in the course of a few months from the time of the first ulceration. The treatment can be only palliative.

Fibroma.—Fibroma and osteo-sarcoma of the auditory canal have been removed successfully with the galvano-cautery snare by Scheibe.

Carcinoma.—Carcinoma of the auricle and cartilaginous auditory canal in a child of seven has been successfully operated upon by Decker.¹

Adeno-carcinoma of the cartilaginous auditory meatus and the squamous and mastoid portions of the temporal bone, in a woman of sixty-two, is reported by F. B. Sprague.² The initial symptoms in the ear—tinnitus, deafness, and pain—occurred two years before the patient was seen by him. An operation for the removal of two large tumors near the meatus auditorius revealed the fact that the cartilaginous part of the

¹ Ann. des Mal. de l'Oreille, October, 1894.

² Transact. Amer. Otol. Soc., July, 1899.

canal was encircled by a hard fibrous growth nearly filling the canal and extending into the glenoid fossa, but not connected with the parotid gland. It was also found that the upper bony wall of the external meatus was black and soft, the necrotic condition extending to the tympanum and through the entire thickness of the bone to the dura, into the mastoid cells, and to the squama. The dura was dotted with isolated growths in several places. All the morbid growth was removed, so far as could be determined. Entire recovery took place in the ear, the hearing became normal, and the patient remained cured for six months, when symptoms of deeper involvement of the ear and cranium set in, and in two months the patient died.

CHAPTER XII.

ACUTE AND CHRONIC INFLAMMATION, INJURIES, AND MORBID GROWTHS OF THE MEMBRANA TYMPANI.

Acute Myringitis.—In many cases it is of great clinical convenience to speak of an inflammation of the drum-head ; but it is not easy to describe, anatomically, such a disease of the ear.

Clinically, myringitis may be classed among diseases of the ear, for the fact is that an inflammation of the skin of the external canal, or of the mucous membrane on the inner surface of the membrana tympani, having culminated in the drum-head, will produce such modifications in that membrane as to demand attention somewhat different from that necessary if the inflammation occurring in these constituent structures had localized itself elsewhere. As an idiopathic disease, myringitis is of rare occurrence ; as a secondary event, very frequent.¹

Symptoms.—A typical case of so-called myringitis is characterized by pain and tinnitus, but not intense hardness of hearing at first. Upon inspection it will be seen that the membrana tympani is congested, usually very greatly if the disease has advanced, but that its position is not abnormal, and that the adjacent wall of the auditory canal is little or not at all congested. At the same time the Eustachian tube may be found entirely free, and the membrana tympani will give no evidence by bulging that there is secretion in the tympanum.

By further watching such a case, it will be found that the membrana tympani becomes gradually thicker from infiltration, and at last pus will be found on the outer surface, without the existence of a spontaneous perforation in the membrane. On wiping away this product of inflammation, the outer surface of the membrane will be found very red, in some cases almost granular, and it will bleed if touched roughly. This condition of breaking down may go on until an ulcerated spot is at last formed on the outer surface of the drum-head. The latter may lead to a perforation of the membrana tympani by erosion from without inward. In the mean time, however, the hearing does not suffer as it does when the tympanic cavity is primarily and chiefly affected by disease. As I have assured myself, by means of the catheter and by incisions through the drum-head, that the tympanum is free from disease in all such cases as could be termed myringitis, I am disposed to consider so-called myringitis an inflammation usually, if not always, of the dermoid layer of the drum-head. In fact, there is in such cases a *myringo-dermatitis* charac-

¹ Gruber, Monatsschr. für Ohrenheilkunde, 1875, Nos. 9, 11, and 12.

terized by the formation of blebs below or behind the manubrium. It may occur from exposure to cold water, cold air, the entrance of any irritant into the auditory canal, or in the course of measles.

Dry heat will control the pain in such cases, and spontaneous rupture of the blebs should be awaited. Paracentesis is rarely advisable for fear of puncturing at the same time the other layers of the drum-membrane, and, by thus admitting septic serum to the drum-cavity, causing inflammation of this space.

Syphilitic Exudation.—Syphilitic exudation in the folds of the membrana tympani about the head of the malleus may occur in subjects with syphilitic history and chronic catarrhal deafness in the affected ear. This may be attended with pain in the ear and mastoid tenderness. Recovery occurs under the use of iodides.

CHRONIC INFLAMMATION.

Ulcers in the Dermoid Layer.—As a consequence of acute external otitis or of acute myringitis, ulcers may form on the membrana tympani. The first stage of such erosion would implicate the outer layer, while subsequent advances of the disease would involve the deeper layers. Hence an ulcer on the drum-head may assume a terraced shape, the upper stratum being the dermoid, the middle the fibrous, and the inner the mucous layer of the membrana tympani.

Symptoms.—Such a process on the drum-head may be attended with tinnitus aurium and some loss of hearing, but pain is entirely absent. The attention of the patient is called to the ear partly by hardness of hearing and the subjective noise, but chiefly by the scanty and slow discharge. The scantiness and slowness of the discharge lead to a hardening of it about the meatus, and, the ear feeling dry and stiff, the patient is inclined to pick at it. By such manipulation, dry scales of dark matter are pulled from the meatus, and are usually another incentive to the patient to seek medical aid.

Prognosis and Treatment.—The prognosis is favorable if the proper treatment is carried out, but, like every other aural disease, this tends to chronicity in the most favorable circumstances if not properly managed.

Should the condition of the patient demand constitutional remedies (and it always will, according to my observation), some form of iron will be found of great benefit. The syrup of the iodide of iron or some one of the numerous preparations of iron and cod-liver oil will render good service in these cases.

The local treatment is of the greatest importance in ulceration of the membrana tympani. It is, therefore, necessary that the surgeon should mop the external auditory canal, the drum-head, and the inner end of the canal with absorbent cotton on the cotton-holder. This should be done very carefully and thoroughly, under good illumination of the canal by means of the forehead-mirror. To attempt to cleanse an ear by

swabbing it out without such illumination is worse than useless; it is always painful and usually injurious.

The existence of a perforation in the membrana flaccida, excepting, perhaps, the central variety, indicates serious disease in the upper part of the tympanic cavity. As the bulk of the malleus and incus lies in the dome of the tympanum, directly behind the membrana flaccida, there is necessarily an impediment offered by them to the escape of matter from the cavity of the drum when the only perforation in the membrana tympani is in the flaccid part. This subject will be considered farther on.

INJURIES OF THE MEMBRANA TYMPANI.

The membrana tympani is liable to a number of perforative injuries from without. These, while not directly interfering greatly with the function of hearing, unless at the same time they affect deeper parts of the organ of hearing, usually expose the mucous lining of the tympanic cavity to the direct irritation of the external air, and thus lead secondarily to tympanic inflammation and loss of hearing.

Prominent among the causes which lead to traumatic rupture of the drum-head may be cited "boxing the ear" and receiving the force of a wave on the ear while bathing in the sea. The healthy membrane will usually resist these forces, but one that is any way diseased by fatty degeneration, atrophy, or calcareous deposits, or one prevented from assuming proper equilibrium by a closure of the Eustachian tube, is extremely liable to yield to the external violence above named.

The drum-head may receive very injurious concussion from diving into the water, from the discharge of musketry or of a cannon, from falls or from a gunshot wound near the ear, as, for example, in the upper maxilla and the horizontal plate of the ethmoid, and also from the kick of an animal on the mastoid process. The membrane is also frequently injured by the introduction of long and slender instruments into the auditory canal. It is often injured, in fractures of the temporal bone by blows on the chin, by impaction of the maxillary condyle against the anterior wall of the auditory canal and annulus tympanicus, and by "boxing the ear." These accidents are usually accompanied by hemorrhage, but this, if unaccompanied by the escape of serum, is not a grave symptom. The escape of serum, either with or without blood, especially if copious, is indicative of fracture of the base of the skull, involving the internal, middle, and external ear.

Congenital Perforation.—It must be borne in mind that there may be a congenital perforation of the membrana tympani, as shown by Gruber¹ and Bochedalek.²

The membrana tympani has been found ruptured in those who have

¹ Med. Press, March 6, 1895.

² Praeger Vierteljahrschrift, 1866.

been executed by hanging. In such a case the fissure of the drum-head is ragged and runs from the tip of the manubrium downward towards the periphery of the membrane. The edges are everted, but there may be neither blood nor any other fluid in the cavity of the drum. From the eversion of the edges in such a case it might be supposed that the force which breaks the membrane acts from within the tympanic cavity outward. The rupture of the membrane may be explained by supposing that the air in the tympanum at the moment of the fall is thrown into violent concussion, and, not being able to escape by the Eustachian tube, owing to the constriction of that canal by the rope, is forced violently outward, producing the fissure of the membrana tympani. The membrana tympani may be ruptured by an increase in the external atmospheric pressure, if the latter is very extraordinary and if the Eustachian tube is more or less impervious.

The membrana tympani is probably able to endure sudden pressure from without, as in discharges of artillery, musketry, etc., whether expected or not, only through the loose valve-like nature of the Eustachian tube.

Fracture of the Handle of the Malleus.—There are a few cases of fracture of the handle of the malleus on record. This rare accident has been described by Ménière,¹ von Troeltsch,² and R. F. Weir.³

Atrophy of the drum-head may occur in consequence of pressure, long kept up, by a mass of hardened cerumen. This process is favored if the Eustachian tube is at the same time closed.⁴ It is not uncommon to find, in those suffering from chronic aural catarrh and deafness, hardened pieces of ear-wax in contact with the drum-head. Though such an obstruction may add nothing to the existing deafness, it may and often does produce sensations of fulness in the head, and, at times, vertigo. Such cases are apt to escape detection, simply because the patients have given up all treatment, considering their cases hopeless, and are no longer under examination. Although the deafness may remain unchanged after the removal of such masses of cerumen, the cerebral symptoms are greatly relieved.

Medico-Legal Significance of Injuries to the Membrana Tympani.—After a blow has been received on the ear, either during a quarrel or in play, an action at law may be instituted to recover damages for supposed injury to the drum. In such a case the surgeon will be called on to decide, first, whether there has been an injury done the drum-head, and, second, if so, how far it will impair the hearing. In the first consideration he

¹ Gazette Méd. de Paris, 1856, p. 50.

² Treatise on the Ear, p. 151.

³ Ununited Fracture of Manubrium of Malleus, Tr. Amer. Otol. Soc., 1870, vol. i. p. 121.

⁴ S. Moos, Archives of Oph. and Otol., 1869, vol. i. pp. 321, 324.

must bear in mind that the drum-head may have been perforated before the blow was received, though the patient or complainant may or may not know it. The chronic perforation can readily be distinguished from the acute, as the former is rounder and has cicatrized edges, while the latter is irregular in outline and often has dried blood on its edges. If it should be determined, however, that a previously normal drum-head has been ruptured by a blow on, or a thrust into, the ear, it remains for the surgeon to determine whether the hearing has been or will be impaired by the injury. The mere fissuring of a normal membrana tympani in the above way may not necessarily injure the hearing nor oblige the patient to give up his daily work. If, however, there has been a severe blow on the ear, the hearing may be impaired from concussion of the nerve in the labyrinth, which, though associated with rupture of the drum-head, is not necessarily caused by it. If there has been no concussion of the inner ear and no inflammation set up in the drum-cavity, the ruptured drum-head will heal quickly if let alone,—i.e., if nothing is dropped or poured into the ear. Ignorance on the latter score has led very often to the use of drops the moment a fissure in the drum has been noticed. The matters thus poured into the canal, having entered the drum-cavity through the perforation, have set up inflammation in the delicate mucous membrane of the middle ear, and disease has been established where otherwise, by letting the ear intelligently alone, the perforation would have healed in a day or two. Thus, it might appear that a blow had caused the disease which in reality was produced by improper treatment of the ear. If, in a case of asserted traumatic violence to the drum-head, deafness should be discovered by the surgeon, it must be determined whether it has been produced by the same blow which has ruptured the drum or whether it existed before. A temporary diminution of hearing is very likely to occur after a blow on the ear hard enough to rupture the membrana tympani, but if great and sudden deafness comes on after a blow on a previously healthy ear, and if it remains for several days without signs of improvement, it must then be adjudged permanent, and the claim for damages must be in accordance with the facts. Even should it be decided that the injured ear was not in a state of health before the blow, it would seem that all the greater claim could be made by the sufferer. In such a case, however, it must ever be borne in mind that it is not the fissure in the drum-head that has done the damage, but a consequent inflammation in the middle ear, or the concussion of deeper and more delicate nervous parts of the organ of hearing.

Normal Movements in the Membrana.—Hammerschlag¹ has demonstrated that there are normally motions in the membrana tympani synchronous with respiration as well as with the pulsations of the heart. *Aural*

¹ Wiener Med. Woch., September 19, 1896.

myoclonus has been noted by Masini¹ in three cases, all of them men the subjects of dyspepsia and neurasthenia.

MORBID GROWTHS.

Wart-like Bodies on the Membrana Tympani.—Wart-like excrescences on the membrana tympani, first described by Urbantschitsch, I have observed in but one case. There were in this case—that of a man twenty-four years old—two pale yellow warts, about a millimetre in diameter, on the upper and posterior quadrant of the membrana tympani. There seemed to be no explanation for their occurrence, unless it could be found in the instillation of various fluids which the patient had practised on his own responsibility, for some time, for the cure of deafness resulting from chronic catarrh of the middle ear. The constant irritation thus applied to the delicate dermoid layer of the drum-head may have provoked the growth of some of its papillæ into the above-named wart-like bodies.

Vascular Tumors, Moles, and Hæmatoma of the Membrana Tympani.—Vascular tumors, moles, and hæmatoma are sometimes found limited to the membrana tympani. These formations require no treatment unless they interfere with the hearing, when they may easily be removed. In purpura hæmorrhagica, purpuric spots may occur on the membrana tympani and cause perforative inflammation of the drum-cavity.

Endothelial Cholesteatoma.—Endothelial cholesteatoma on the mucous surface of the membrana and cholesteatoma of the dermoid surface of the drum-membrane are sometimes observed. They may easily be removed with a small needle or knife if their removal seems required.

¹ Arch. Ital. di Otol., January, 1897.

CHAPTER XIII.

ACUTE CATARRHAL OTITIS MEDIA.

OVER sixty per cent. of all ear diseases are in the middle ear. More adults than children (three to one) and more men than women are affected with diseases of this part of the organ of hearing.

Diseases of the middle ear are divided into four general classes,—viz., *acute catarrhal*, *chronic catarrhal*, *acute purulent*, and *chronic purulent otitis media*. All these begin as an acute catarrhal process, influenced, of course, by special conditions of health and diathesis in the patient. As a rule, the acute catarrhal process of the middle ear originates in an acute catarrh of the nasopharynx and the Eustachian tube, whence it spreads to the middle ear, which in its normal state is an aseptic cavity. Sometimes it seems that the entrance of cold water, cold air, or some other irritant into the external auditory canal sets up an inflammation in the middle ear; but in such cases it will be found that the nasopharynx was more or less inflamed and supplied the pathogenic germ to the drum-cavity congested from disease in the external ear, thus offering a soil favorable to the growth of streptococci or other pathogenic organisms.

ACUTE CATARRHAL OTITIS MEDIA.

Etiology.—Acute catarrhal otitis media is caused most frequently by acute coryza. It is rarely, if ever, due solely to any form of inflammation of the fauces without concomitant nasal disease. It is also caused by the nasopharyngitis excited in the exanthemata, typhoid fever, and influenza.

The acute otitis media coming on about the third week of typhoid fever is due to the accumulation of secretions, food, etc., and the decomposition thereof in the nasopharynx of the weak and recumbent patient. Sepsis is thence conveyed to the Eustachian tube and middle ear. An acute catarrh is set up in these cavities, and a simple catarrhal otitis media is often soon followed by an acute suppurative otitis media.

Symptoms.—The earliest symptoms of this disorder are a sensation of stuffiness in one or both ears and hissing or pulsating tinnitus, but without pain or altered hearing. Sometimes, indeed, in the early stages the hearing may be hyperæsthetic. Most of us experience this mild stage of acute catarrhal otitis media with a cold in the head. As simple coryza passes off, all ear symptoms go with it, if the local treatment of the nares and nasopharynx has been mild and gentle or purely negative. If the conditions in our own nasopharynxes and middle ears are closely observed when we have a coryza, we shall notice that, as secretion increases in the nasopharynx (but not before), the Eustachian tube ceases to open

at each act of swallowing as it does in a normal state. The ear may feel more or less stopped, and now and then there may be a slight pain running into it from the posterior nares. If in these early stages the nasopharynx, nares, and Eustachian tube receive no local treatment, or only a mild one with a bland oleaginous spray, we shall perceive that, as secretion in the nares and nasopharynx diminishes, in the course of from three to six days, the Eustachian tube will open spontaneously (or with an act of swallowing) and the ear will feel clear once more. This stoppage of the Eustachian tube in the early secretory stages of an acute coryza is beneficial, since it is Nature's seal set against the entrance of pathogenic germs from the nasopharynx into the normally aseptic middle ear. If this seal is broken, either by forcible blowing of the nose, Valsalvian auto-inflation, or the inflation-bag of the surgeon, it is done to the injury of the patient, as pathogenic germs are very likely to be forced by such manipulations from the nasopharynx into the middle ear and an acute purulent inflammation of the drum-cavity set up. Acute catarrhal otitis is as common as acute coryza, and as simple if properly managed; but the transition to acute purulent otitis—a serious malady—will be rapid if the local treatment of acute catarrhal otitis is injudicious.

Diagnosis.—If the membrana tympani be examined in the early stages of a simple acute otitis, it will be seen to have undergone very slight, if any, change. It may look a little pink, or even red, along the malleus and periphery, but its general surface undergoes no change in appearance or position.

Treatment.—All forms of inflation and aspiration of the middle ear, as also syringing and douching the nares and nasopharynx with watery solutions, must be most carefully avoided, since all of these manœuvres tend to force pathogenic germs from the nasopharynx into the middle ear. If the nares and nasopharynx are full of tenacious secretions which the patient cannot gently blow from the nose, a moderate use of a spray of Dobell's solution, or simple fluid petrolatum, once or twice daily for a few days will soften these secretions and favor their outflow; but no inflations or aspirations of the nasopharynx should be employed to open the middle ears. Both doctor and patient should be taught that the stopped condition of the ear or ears is a preventive of worse conditions in the ear, and must be cheerfully endured for a few days. The continued use of watery sprays must be avoided, as they tend to "water-log" the tissues and increase the swelling and discomfort in the nose.

The acute catarrhal otitis media of the exanthemata, of typhoid fever, and of grippe originates also by infection from the nasopharynx, but, owing to the more weakened condition of the patient in these maladies than in simple coryza, it tends to a more virulent course from the outset. Nevertheless, the simpler the local treatment of the nasopharynx and ear in such cases the less likelihood there will be of secondary infection and the more favorable will be the course of the aural disease in the end.

A mild antiseptic nasal spray to cleanse the nasopharynx a few times daily in such cases will be sufficient.

If there be pain in the ear, it can be allayed best with dry heat applied by means of the hot-water bag, hot-water bottle, or hot stone wrapped in flannel. The endeavor to open the stopped ear and to relieve slight ear-pains by inflations, aspirations, and syringings has often converted simple catarrhal otitis media into painful and serious acute purulent otitis media.

Simple catarrhal otitis media, even when painful, can be allayed by the application of dry heat about the ears, combined, in those instances demanding it, with an antifebrile treatment of the general system, if this plan is pursued from the outset of the inflammation. There will be no harm in instilling into the ear, if it pains, ten drops, *warmed*, of a watery solution of carbolic acid (1 to 40), or one of formalin (1 to 1000), if these can be borne.

The advantage of instilling an antiseptic into the inflamed ear in the early stages *before* perforation of the drum-membrane occurs is that the auditory canal is thus rendered to a great degree aseptic; hence it is a safer place for the membrana to rupture into, since, when the membrana ruptures and the germs causing the acute inflammation are poured into the outer ear freed from staphylococci by antiseptic instillations, there is less danger of the entrance of the last-named germs, the promoters of chronic purulency, into the drum-cavity, and secondary infection is less likely to occur.

CHAPTER XIV.

CHRONIC CATARRHAL OTITIS MEDIA.

EVERY case of acute catarrhal inflammation of the nasopharynx affects the ears to some extent. This affection may be only a slight sense of fullness, passing off with the coryza, or there may be a slight dulness of hearing remaining after the acute catarrhal symptoms have passed away. This dulness of hearing may increase after each cold in the head, to which, probably, the patient is specially liable. In other instances the acute catarrhal inflammation passes into an acute purulent inflammation of the middle ear, to be considered farther on. At present it seems convenient to consider those cases that pass from an acute catarrhal into a so-called chronic catarrhal inflammation of the middle ear; these are characterized by disturbances in the trophic nerves of the middle ear. The process at first is usually hypertrophic, but at last there is a distinctly sclerotic condition brought about in the mucous membrane of the middle ear, which process in many cases extends to the internal ear and impairs the acoustic nerve. In only one-quarter of the cases of so-called chronic catarrhal deafness can nasal obstruction be regarded as causing loss of hearing. Too much and too severe treatment has been directed towards hypertrophies of the turbinates as a means of curing deafness. Especially to be condemned in this connection is *turbinotomy*.

SUBJECTIVE SYMPTOMS.

Tinnitus.—The earliest subjective symptoms of this disease are tinnitus aurium and a gradual diminution of the hearing. These symptoms appear usually only in one ear at a time, and a varying period may elapse before the other ear is attacked. The onset of the subjective noise in the ear may be quite sudden; the time of its first occurrence can usually be stated accurately by the patient. This buzzing, chirping, or hissing may appear on rising in the morning, during or after a severe cold in the head, or after a depressing illness. The noise is not intense at first, but gradually becomes louder and more annoying, the hearing usually diminishing at the same rate. The statements of patients as to the quality and character of the subjective aural noise vary extremely. The objective sounds to which they are likened are commonly taken from the sounds to which the patient is most exposed. In many cases a hyperæsthesia to objective sound seems to come on with the annoying subjective noises. All subjective noises of the ear in this disease may be increased by fatigue, drinking spirits, smoking, and prolonged conversation. In some cases the noise seems much louder after each meal. Some authori-

ties state¹ that abnormal conditions of the genito-urinary apparatus tend to aggravate the tinnitus of chronic aural catarrh. It is very certain that gastric and intestinal derangements tend to make tinnitus aurium more intense. But in some cases tinnitus aurium either never appears in the disease or only at a later stage, long after the hearing is much reduced. These cases, being deprived of the warning as to the threatened failure of the function of the ear found in tinnitus aurium, are rarely made aware of the loss in hearing until it becomes very great. This is especially the case when one ear remains perfect. A failure of hearing in the good ear, temporary or otherwise, is often the first occasion for noticing the defect in the other ear.

The coming on of this kind of deafness is so insidious that in many cases, even among the most intelligent, there is no reliable history of the origin of the disease. These cases with no definite account of the beginning of deafness seem, in my experience, to belong to a class with hereditary tendencies to chronic catarrh of the nasopharynx and middle ears.

Pain.—Darts of pain are felt in some cases every day or two, but this is not a very frequent symptom. If it occur, it is only in the earlier stages. Most patients complain of fulness and discomfort in the ear as the disease advances. If the secretion of mucus is considerable, more or less cracking is heard in the ear by the patient. After the ear cracks, it seems open for a little while, and the patient may hear better. But in a short time the feeling of stoppage returns, and the hardness of hearing is again present. The pain and the sense of fulness are increased by changes in the weather during the winter season. In summer all such symptoms are very much less prominent.

Fauces.—With the tinnitus aurium, loss of hearing, and darting pain in some cases, disagreeable sensations are felt in the fauces, throat, and larynx. The character of these subjective conditions is variously described by the sufferers. Most of them complain, however, of constriction, tickling, sensation of fulness, and burning in the throat. All of these are aggravated by cold, by any depressed state of health, by stimulating food, and by dyspepsia with constipation. In some instances, after a hearty meal, the throat will feel more or less burning, which is aggravated if the patient is obliged to talk for any length of time. Very often the disagreeable feeling in the throat is described as like that caused by a hair or other foreign substance lying in the fauces, and which remains there notwithstanding all efforts at swallowing.

Ear-Vertigo.—Attacks of ear-vertigo come on suddenly, occurring once or twice a year at first, and are usually not referred to the ear as a cause either by the patient or his physician. In fact, they are commonly considered and treated as attacks of stomachic vertigo or as neurasthenia. In

¹ Weber-Liel, *Progressive Schwerhörigkeit*, S. 19.

some instances the attacks of ear-vertigo are preceded by an increase in the tinnitus aurium, and this may arouse *in the patient* a suspicion that the *ear disease* is the cause of his vertigo. When chronic ear-vertigo sets in, it is in the later stages of chronic catarrhal deafness, and the deafness is generally profound in the ear or ears affected. In every case of chronic catarrhal otitis media there occur, very early in the process, contraction of the tensor tympani, retraction of the chain of auditory ossicles, and consequent impaction of the stapes in the oval window. It is this last event that causes compression of the intralabyrinthine fluid and irritation of the motor filaments of the auditory nerve and cerebellar peduncles, with reflex phenomena of vertigo.

If these attacks of ear-vertigo once set in, they gradually increase in frequency from once in six months to once a month, and finally once a fortnight. As the patient suffers from nausea and vomiting, as well as inability to walk steadily, or even at all, and as he may be seized by vertigo in the street and be mistaken for a drunken man, he is unwilling to leave the house alone. His business is interrupted, his nervous force gives out, and his general condition becomes deplorable. Unfortunately, he is often treated now for "neurasthenia," "epilepsy," and even "apoplexy," instead of ear-vertigo. The fact that a patient with ear-vertigo never loses consciousness in his attacks serves to render the differential diagnosis positive.

Hearing Better in a Noise.—Hearing better in a noise is very often a marked symptom of the later stages of chronic aural catarrh, when the tympanum has become dry and sclerotic, or when the thickening of the mucous membrane has become great in the moist form of the disease. Those presenting this symptom (*Paracusis Willisiana*) are found upon examination to hear the ticking of a watch somewhat better in a noise—for instance, in a mill or a railway train—than in a quieter place. No entirely satisfactory explanation of this condition has yet been given.

OBJECTIVE SYMPTOMS.

Appearances in the External Auditory Canal.—It may be said that in chronic aural catarrh characteristic changes occur in the external auditory canal. Chief among these is the diminished or suspended secretion of cerumen. The ear-wax not only becomes smaller in amount, but often assumes a brittle quality; later it often ceases to be formed at all. This points to a great alteration in the nutrition of the organ of hearing. This important excretion ceasing to be poured into the auditory canal, there set in a dryness and scaly condition of the skin of the meatus.

Membrana Tympani; Changes in Color.—The membrana tympani usually loses its lustre and transparency in chronic aural catarrh. But as these changes are not always indicative of such a disease in the tympanum, they must never be regarded as of positive value. In some cases of

chronic catarrh of the middle ear the membrana tympani may be thinner than usual, and cases are observed in which the lustre remains unchanged. In the latter instance the chronic alterations in the mucous membrane of the middle ear have occurred elsewhere than on the inner surface of the drum-head; in fact, these usually take place at the stapes. The membrana tympani may appear uniformly pink from the transmission of the redness of the congested mucous membrane on the promontory. Another important fact to bear in mind respecting color-changes in the drum-head is that, even in those with normal hearing, especially in children, the membrana tympani is not infrequently rather dull in appearance for longer or shorter periods. The lustre of the membrane is most easily lost; alterations in tenuity are more indicative of a deeper change in structure.

Calcareous Deposits.—Chalky spots may be found in the drum-head of an ear affected by chronic catarrh, but they cannot be considered characteristic of the disease. They are usually traceable to a previous purulent disease in the ear, all other traces of which have gone, for it is not uncommon to find these deposits entirely unaccompanied by hardness of hearing.

Changes in Position of the Membrana Tympani.—A much surer objective symptom of chronic aural catarrh, especially when joined to opacity and loss of lustre, is a retraction of the membrana tympani. The drum-head then appears drawn in and the manubrium of the malleus foreshortened, the short process of the latter projects more sharply than usual, and the folds of the membrana tympani are very prominent. The manubrium is not only indrawn, but is pulled backward and upward, and, the entire concavity and curves of the drum-head being thus altered, the pyramid of light, normally found in the antero-inferior quadrant, is very much changed in position, or it may disappear altogether. As the latter reflection depends on the lustre as well as the curve and position of the drum-head, and as more or less opacity is found in chronic aural catarrh, the normal pyramid of light is usually one of the first features to vanish from the diseased membrane. The manubrium not only is indrawn, but it is rotated about its long vertical axis so as to pull the posterior half of the drum-head into greater prominence and to drag the anterior half into a greater depression.

Nares.—The changes in the nares often attending, and apparently in many cases promotive of, chronic aural catarrh may be very great. Most important is hypertrophic catarrh of the nares in these cases. The hypertrophy is usually most prominent on the inferior turbinated bones, though it may invade all the membranous structures of the nostrils, either on the turbinated bones or upon the septum. Posterior nasal hypertrophies are the most important, on account of their proximity to the faucial end of the Eustachian tube. There are often found enchondromatous enlargements on the septum, deviations of the septum, and other forms of obstruction in the nares in the subjects of chronic aural catarrh.

These obstructions, augmented by the hypertrophic mucous membrane, interfere with normal nasal respiration and lead to mouth-breathing. Thus the throat becomes affected by the irritation of direct respiration, and the nares and nasopharynx become further affected by being deprived of the normal stimulus of nasal respiration. The Eustachian tube, deprived of the natural stimulus of nasal respiration, fails to become patulous as often as it should, and may remain closed for long periods, and the drum-cavity is thus deprived of its normal quantity of ventilation. This condition, in turn, retracts the membrana tympani, fixes the ossicles, and tends to the production of ankylosis in the sound-conducting apparatus of the middle ear.

The Condition of the Pharynx and Throat.—The pharynx, tonsils, and velum will be found to present varying appearances according to the form of the disease.

In the *moist* form the secretion of mucus will be markedly increased and the glandular structures of the mucous lining of the fauces will appear enlarged and inflamed, their function at first being, of course, stimulated by the disease. The tonsils are usually very much enlarged in this form of the disease, and the velum appears swollen. But this tonsillar hypertrophy is only an accompaniment of the general catarrh, not the cause of the catarrh in the ear nor of the hardness of hearing. It will very often be found that the most swollen tonsil is on the side of the better ear. The secretion of the nose is also very apt to be abnormally great.

Sclerotic Symptoms.—But many cases of chronic aural catarrh do not continue to show this abnormal amount of secretion in the pharynx. In these cases the mucous membrane has either rapidly ceased to throw off large quantities of mucus or it has slipped at once into an atonic and *dry* state. In such cases the mucous membrane of the entire pharynx, especially on the posterior wall, is pale and, at spots, apparently absorbed.

The *velum* appears rather thinner than natural, as though its muscular structures were absorbed, as indeed they are; and the *raphe* is no longer directly in the median line, nor are the halves symmetrical in shape and position. A paresis has apparently affected one-half more than the other, and the uvula and the weaker half will be drawn towards the stronger side, which will usually be found to agree with the better ear. All of these changes in the action of the muscles of the fauces must be attributed to the effects of the catarrh.

Loss of Function in the Velum.—The loss of normal mobility in the *velum* is further seen when the patient is told to phonate the vowel *a* broad. Then the velum and uvula, instead of rising quickly to shut off the lower from the upper pharynx, will fail more or less to fulfil this function. The uvula either hangs loose and downward, quite relaxed, or it clings to one or the other side, on the edge of the velum. As the patient phonates, the uvula may slip from this position on the velum and hang loosely downward, or it may curve forward, or backward against

the posterior wall of the pharynx. In such conditions, sudden eructation, coughing, or sneezing may at times produce pain in the ear. It is also very noticeable that the act of swallowing cannot be performed rapidly by persons thus affected in the faucial muscles.

Changes in the Voice.—With these alterations in the ear and throat, the vocal functions usually become weaker. The timbre of the voice is altered, and, if the patient has been a singer, the voice is found to be rapidly losing musical power. A kind of hoarseness sets in when singing or prolonged conversation is attempted. The voice "breaks" or "cracks," and a general sense of fatigue in the throat becomes a prominent and distressing symptom. All of these alterations in the throat usually begin to appear before the morbid changes in the ear. The latter seems to become affected by a passing inward and upward of the nasal and throat disease through the tube into the tympanic cavity. When once there, a long series of nutrient changes begin, which, with varying symptoms, usually terminate in total deafness; though in some cases chronic aural catarrh seems to stand still after having impaired, but not destroyed, the function of the ear. A marked characteristic of chronic aural catarrh is not only to advance slowly and surely in one ear, but to pass to the other sooner or later.

Objective Changes in the Eustachian Tube.—As may be inferred from what has been already said, the Eustachian tube, being lined with mucous membrane continuous with that of the fauces and of the tympanic cavity, and forming such an important part of the middle ear, undergoes serious and most important changes in chronic aural catarrh. These changes are due primarily to thickening of the lining of the tube or to obstruction of its caliber by mucus.

Adenoid Growths and Granulations in the Nasopharynx.—In a number of cases of chronic aural catarrh there are found adenoid growths and granulations in the nasopharyngeal space. These growths are described as benignant in nature and more or less leaf-like or conical in their shape. They are usually situate quite high in the nasopharynx, are extremely delicate, and hence bleed on being touched. Their height or length rarely exceeds three centimetres, and their breadth or thickness varies from a few lines in the smallest to one or two centimetres in the largest. As might be supposed, such growths interfere not only with respiration and enunciation, but also with the normal ventilation of the Eustachian tubes and tympana.

The symptoms are a tendency to bleed whether touched or not, alteration in the pronunciation of certain vocal sounds, as *m*, *n*, and *ng*, and a great change in the facial expression, from the falling in of the alæ of the nose and the respiration through the mouth necessitated by the obstruction in the posterior part of the nares. The hearing, too, will in time become greatly lessened from the chronic stoppage in the Eustachian tubes and the interference with the normal ventilation of the middle ears.

A nasopharynx thus affected is apt to secrete large amounts of tough greenish mucus, the velum may be swollen, and the lower pharynx chronically inflamed. On the other hand, these growths may be present in the nasopharynx without any marked accompanying changes in the pharynx and velum. Not uncommonly, the altered enunciation, respiration, and facial expression arouse a suspicion of their presence, which is subsequently confirmed by rhinoscopic examination and manipulation with a probe or the finger, the latter causing the growths to bleed.

The Objective Effects of Diagnostic Inflation upon the Membrana Tympani.—The effects of inflation upon the membrana tympani are among the most important objective symptoms. More or less bulging of the drum-head will be caused by inflation. If the handle of the malleus is held retracted, by alteration in the mobility of the tendon of the tensor tympani, this bulging of the membrane will occur behind and before the manubrium; but if the manubrium is not held in, as above suggested, then it and the membrane will be moved more or less as a whole. At the same time, if there is movable fluid in the cavity of the drum, it will be forced against the membrana tympani and modify the picture presented to the observer. Bubbles may be seen then distinctly through the membrane, or inspissated secretion may be found to change position in the drum.

A most interesting and instructive change, produced by inflation, in the appearance of the drum-head is the forcing outward of depressed spots or cicatrices. Unless this symptom is sought for promptly after the air is forced into the tympanum, it may escape notice.

Very often depressed cicatrices are considered retractions adherent to the inner tympanic wall, but on inflation these depressions may not only return to the plane of the rest of the drum-head, but not uncommonly they project beyond it into the auditory canal, forming thus blister-like spots. In some cases these are filled only with air; in other cases they are filled with brownish fluid, which will give them an amber tint. Not only will these appearances come out on the drum-head by inflation, but they can be produced very easily under suction by Siegle's pneumatic speculum.

This latter method of examination of the drum-head is of the greatest value, for, when the tube is stopped up and absolutely impervious to air, the pneumatic speculum or its equivalent becomes the only means of producing movements in the drum-head, and secondarily of the contents of the drum-cavity.

Not uncommonly inflation of the tympanic cavity, especially by Valsalva's or Politzer's method, produces objective sounds, readily audible without the aid of the auscultation-tube. Especially is this observable when the entire drum-head is flaccid and easily moved to and fro, or when, in a comparatively normally tense membrane, flaccid scars are found.

The sound produced in either instance is that of a loose crackling of the flaccid tissue. In a case recently observed, so loud was this crackling sound that it was heard across a large room, not only during Valsalva's method of inflation, but also during rapid breathing through the congested nares, the mouth being kept closed. Valsalva's method of auto-inflation consists in closing the mouth and holding the nostrils with the fingers, while the breath is forced into the Eustachian tubes and tympanic cavities.

Malignant Growths in the Nasopharynx involving the Ear.—Malignant neoplasms in the nasopharynx may involve the ear at an early period of their growth, as shown in a case of *small-celled sarcoma in the vault of the pharynx*, observed by the author.

Emphysematous Tumor over the Mastoid.—Natural dehiscences in the mastoid portion of the temporal bone sometimes persist, and favor the escape of air from the middle ear and mastoid cavity to beneath the skin lying over the latter, as has been observed in a case reported by Wernher. Compression long kept up having failed, in the case reported, to produce a cure, a successful endeavor was made to set up adhesive inflammation between the edges of the dehiscence and the superjacent soft tissues. This was accomplished by means of subcutaneous injections of tincture of iodine at various points in the tumor.

Hairs in the Mastoid Cells.—Another curious condition of the mastoid cavity is the occurrence of hairs within it, as related by the late Mr. Toynbee. The hairs in this case were firmly embedded in the mastoid cells and surrounded by masses of epidermis.

Objective Snapping Noises in the Ear.—Sometimes there occurs in chronic aural catarrh a snapping noise in the ear, which is audible not only to the sufferer but to others. This noise has been likened to the snapping of the fingers, or to the sudden drawing apart of the finger-ends when slightly moistened with saliva or a tenacious fluid.

The spasms in the muscles in such cases are to be accounted for by the catarrhal irritation conveyed to the sensitive nerves of the mucous membrane in the vicinity of the muscles affected. The irritation is thus conveyed to the motor nerves of the muscles in the catarrhal tract, and the latter, in an endeavor to eject the irritant, are thrown into a series of clonic spasms.

Simultaneous Spasm in the Soft Palate.—In the vast majority of all the cases on record, this noise, whether voluntary or not, has been accompanied by a spasmodic elevation and retraction of the soft palate and sometimes of other muscles of deglutition.

Simultaneous Twitchings Elsewhere.—In some instances the involuntary objective noise in the ear has been accompanied by simultaneous ambilateral twitchings of the muscles of the brow, nose, and face, or with simultaneous spasms of the mylohyoid muscle, of the anterior belly of the digastric, of the pterygoids, and in the brow on the same side.

There may be neuralgia in the brow and amyosthenia of the fingers on the side corresponding with the ear in which the noise is heard.

The age of those thus affected varies from five to fifty years. Involuntary objective noises in the ear, and the attendant symptoms already described, rarely occur on more than one side at a time.

The mode of the occurrence of the involuntary snappings in the ear varies greatly. It may be too rapid to be counted (Schwartz), or isochronous with the pulse, and so loud as to waken the patient at night (Boeck), or it may resemble the ticking of a watch, with pauses (Schwartz).

The state of the hearing in an ear thus affected varies, being in some cases normal, in others noises occur in an ear already somewhat hard of hearing, while in some the hearing is momentarily affected, apparently by the altered tension which ensues in the tympanum with each spasmodic occurrence of the noise.

Treatment.—The whole number of these cases is comparatively small and the individual experience in regard to them limited, so that our knowledge respecting the therapeutics of this variety of aural disease has been very meagre. So far as we can glean an opinion from what has been written by others concerning the treatment of these cases of clonic spasms, the induced current has effected the only apparent relief and cure (Schwartz, Politzer, and Boeck). This I have tried without any good effect. Since spontaneous perforation of the membrana tympani in a case observed by me was soon followed by entire cessation of the clonic spasm in the velum and elsewhere in the ear, and of the peculiar noises in the ear, I would recommend artificial perforation in any similar case, if speedy relief from the symptoms should be urgently required, or if they should not yield to treatment of the *catarrh of the nasopharynx which so evidently underlies them as the true cause*. The treatment the author has found beneficial in these spasms is one directed to the inflamed nares and nasopharynx.

SEQUELÆ OF CHRONIC CATARRH OF THE MIDDLE EAR.

Just as there are diseases of the internal ear consequential to purulent diseases of the middle ear, so are there some affections of the internal ear manifestly due to catarrhal disease and consequent trophic vascular and nervous changes in the mucous membrane of the middle ear.

The Internal Ear in Nephritis.—The nature of the labyrinth affections occurring in nephritis is difficult to estimate, as there are no autopsies on record. In such affections neither otoscopic nor functional examination guides to a localization of the lesion. Increased arterial pressure, causing distention of the labyrinth vessels and paralysis of the sound-perceivers in the cochlea, has been suggested in explanation. Rosenstein has suggested the possibility of an œdema of the auditory tracts as the cause of defective hearing in nephritic patients. Others assume that transitory

œdema causes temporary functional disturbances in parts of the brain. As œdema disappears, tinnitus aurium ceases and the hearing improves. Uræmia without œdema also causes deafness by involvement of the auditory nerve and central acoustic tracts. In some instances the "loss of hearing, with the changed condition of the urine, is the only sign of an existing nephritis" (Morf). In fact, deafness is considered a symptom of chronic uræmia by some observers.

According to Dieulafoy, ear symptoms are present in fifty per cent. of nephritic cases, slightly less frequent than eye symptoms. Sometimes the sudden, unexplainable *ear symptoms* are the *first* in a case of nephritis. In any instance of ear symptoms without well-known cause it is well to examine the urine.

In regard to nephritic affections of the internal ear, "there is a number of facts that indicate that we have to deal with the auditory nerve and its peripheral and central distribution" (Morf). According to Gradenigo, affections of the trunk of the auditory nerve are characterized by diminished or lack of perception of the middle tones of the scale, while in labyrinth affections (peripheral) perception of high tones is interfered with, while the middle and low tones are well heard. He also holds that in affections of the auditory nerve-trunk the electric irritability of the nerve is increased. In some instances it is possible that in chronic nephritis the auditory tracts become interrupted by interstitial hemorrhages.

The Ear in Mumps.—Profound trophic changes in the middle ear often occur rapidly in mumps, and extend apparently to the internal ear. It has seemed to me that protection of the body, keeping the patient in bed, as in a case of scarlatina, will ward off disease of the ear in mumps as care of the patient saves the kidneys in scarlatina. If deafness and vertigo do occur in mumps, treatment with pilocarpine, beginning with small doses and gradually increasing, has been found efficient in producing entire cure. It may be necessary to keep up this treatment alternately with quinine for several months before entire recovery takes place.

When the middle ear alone is affected after mumps, there is some hope of recovery of hearing, but there is none when the internal ear is attacked. Gruber maintains that bilateral deafness after mumps is incurable.

The chronic vertigo that sometimes follows the otitis of mumps can be cured by surgical removal of the incus, the membrana, malleus, and stapes being left in position.

The Ear in Tabes.—Lerner¹ maintains that chronic deafness may appear under two forms in tabes,—viz., (1) sclerosis of the middle ear, due to trophic disturbances in the fifth and glossopharyngeal nerves, and (2)

¹ Monatssch. f. Ohrenh., October, 1898.

nerve deafness, due to change in the nuclei, trunk and branches, and terminal parts of the auditory nerve. The disease is usually ambilateral.

The Ear in Endocarditis.—Habermann¹ reports a case of unilateral absolute and permanent deafness, due to an embolus in the stylomastoid artery, in a man of fifty-six, the subject of chronic endocarditis that had been productive of numerous peripheral embolisms.

Traumatic Osteomyelitis and Consequent Anæmia; Effects on the Internal Ear.—Functional and, finally, structural changes in the nervous apparatus of the ear may be induced by traumatic osteomyelitis and the anæmia consequent upon the necessary operations on the bone, as shown in a case reported by Wagenhäuser.²

Epilepsy from Ear Disease.—Verdos³ maintains that in epilepsy *ab aure læsa* there is a characteristic aura beginning in the auditory apparatus. In fact, every epileptic in whom the aura begins in the ear should be examined by an aurist, who in many instances will give great aid in the treatment. In some cases of manifestly aural epilepsy the aura does not start in the ear, but in one of the extremities; later, however, it appears in one ear. This is a valuable diagnostic sign.

Senile Changes.—The predominant senile change in the middle ear is atrophy of the bone, particularly in the ossicles (Ferrer). Osseous changes in the oval window also play an important part in the deafness of old age (Politzer). The pathogenesis of senile deafness lies in atheroma of the arteries, according to some observers, extending at last to the internal ear.

Thyroid Gland.—Spear⁴ asserts, as a result of his own observations, that the *thyroid gland* is "the centre of a nervous system which controls, through connections with sympathetic ganglia and distant nerve-centres by a peculiar inhibition, all the blood-vessels and the centre of the circulatory system, the heart itself." He has presented a number of cases tending to prove that frequently aural symptoms, tinnitus and deafness, accompanied by enlargement of the thyroid, are due to disease of this latter organ, and are relivable, more or less entirely, by hot-water applications to the thyroid gland.

Nerve Deafness and Hysterical Deafness.—"Nerve deafness," like "hysterical deafness," due to primary internal ear disease, cannot be shown to exist. In all such asserted cases either a preceding or an attendant catarrhal affection of the middle ear can be shown to be the underlying cause of the aural symptoms, possibly modified in some cases by a neurotic diathesis.

Ankylosis of the stapes enfeebles but does not abolish hearing. There-

¹ Annales des Mal. de l'Oreille, January, 1899.

² Arch. f. Ohrenh., February 10, 1899.

³ Annales des Mal. de l'Oreille, March, 1896.

⁴ Boston City Hospital Reports, 1896.

fore, when the deafness is profound and the stapes ankylosed, the abolition of hearing is due to a lesion in the labyrinth.

Functional impairment of the auditory centre occurs as a result of catarrhal deafness. This is analogous to the atrophy of the auditory centre supposed by some to occur in deaf-mutes.

Effects of Quinine and Salicylic Acid.—Large doses of quinine and sodium salicylate produce both hyperæmia and extravasation of blood in the middle and internal ears. Doses of from sixteen to thirty-two grains at a time, given to cats and dogs, produce death in from five to eight hours, and at the autopsy are found extravasations of blood and fluid in the labyrinth cavities sufficient to destroy hearing had the animal survived the dose. Grunert¹ has shown that such results in the ear are due to the poisonous effects of the drugs and not to strangulation, with symptoms of which the animals experimented upon died. It is reasonable to suppose that relatively large and oft-repeated doses of these drugs given to man would readily produce organic changes in the middle and internal ears, resulting in permanent destruction of hearing.

Hysterical Mastoiditis.—So-called hysterical mastoiditis seems to be only neuralgia in neurotic women, made worse by their own manipulations of the external ear.

¹ Arch. f. Ohrenh., November 30, 1898.

CHAPTER XV.

TREATMENT OF CHRONIC CATARRHAL OTITIS MEDIA.

IN treating chronic catarrh of the middle ear, the particular form presenting itself, either the moist or the dry, must be kept sharply in mind. Since chronic catarrhal otitis media is caused by chronic hypertrophic nasopharyngeal catarrh, and not by throat disease, the nasopharynx must receive the first attention, and the general health be improved, if impaired, as it generally is. The treatment of the nares must be non-irritant, otherwise the ear disease will get worse. Oleaginous sprays are much better than watery sprays, since the former do not "water-log" the tissues like the latter. Furthermore, oily sprays are considered more efficient germicides than water.

Inflations of the tympana are not only valueless, but often injurious, as they but tend to force pathogenic germs into the middle ear, and shock the auditory nerve by impact on the fenestræ of the labyrinth, especially in the sclerotic form.

Applications to the Nares, Nasopharynx, and Throat.—Medicated applications to the nares, nasopharynx, and fauces are of great importance in the treatment of chronic aural catarrh. From what has been said elsewhere, it will be seen that from the nature of the origin of this disease in many instances, treatment of the parts just named would be indicated. In the vast majority of cases of chronic catarrh more benefit is derived from the proper treatment of the nares and nasopharynx than from direct medication of the tympanum. The latter is probably not as often reached by injections aimed at it through the Eustachian tube as is supposed, and, if reached by such substances, is more frequently injured than not. In every case of chronic aural catarrh the first lesion in the tympanum has been due to want of sufficient air in the cavity. This, of course, has come about by the occlusion, either temporary or permanent, of the Eustachian tube. Such being the case, the treatment must aim at the removal of this obstruction to ventilation of the tympanum and to its effects. The latter may have continued so long as to be irremediable, but the first aim in the treatment should be to restore the tube to its physical function as conveyer of air to the tympanum, and endeavor to check the advance of the disease.

There are, however, some cases of chronic catarrh of the middle ear in which the Eustachian tube is found to be pervious both to natural and artificial inflation, and yet the hearing is much impaired. In these cases it will be found that the lining membrane of the tympanum has under-

gone a change, generally sclerotic, and that the conductors of sound in the tympanic cavity have become stiffened by the chronic disease in the mucous membrane.

Although the tube is found pervious in these cases when examined by the surgeon for the first time, there must have been a period in the history of the process when the tube was stopped up, and thus aided in bringing about the condition of the drum-cavity just mentioned.

Let us first consider the local treatment of a case of hypertrophic or secretory nasopharyngo-aural catarrh. At the outset it must be borne in mind that, as a rule, no watery solutions must be used in this disease, oils being far preferable, and that the patient cannot carry out the treatment on himself, nor can it be applied for him at home by a friend or nurse. In addition to these injunctions, it must be stated that the nares are never to be cleansed or treated by syringing or lavage in any form. The nasal douche has done far more harm than good to the nares and the ears.

Direct Medication of the Nares and Nasopharynx.—Direct medication of the nares and nasopharynx may be accomplished by instillations, by applications conveyed into these parts on cotton twisted fast to the end of a cotton-holder, and by sprays and vapors.

The hypertrophied mucous membrane of the turbinated bones, especially that of the inferior turbinated bone, may be touched with a mixture of iodine and glycerin in equal parts, or with an iodine mixture, composed of potassium iodide, thirty-six grains; tincture of iodine, six grains; distilled water or glycerin, one fluidounce.

When the anterior hypertrophies of the turbinated bones are to be touched, the nostrils must be dilated either by Kramer's speculum or by a short hard-rubber nasal speculum very similar to a wide, short aural speculum. The latter remains in position by itself; the former must be held by the surgeon. The illumination should be by the forehead-mirror. The medication to be applied is then conveyed to the anterior hypertrophy, or it may be carried along the entire length of the inferior turbinated bone to the posterior part of it, or to the posterior pharyngeal wall. Care should be taken not to touch the under edge of the turbinated bone nor the floor of the nose, as these parts are very sensitive. Hence the cotton-dossil must not be dripping nor too large. Neither must it be soaked, for in that case, if it is squeezed, excess of fluid will fall from it upon these sensitive parts as it is passed or pressed upon the less sensitive side of the turbinated bone. In all forms of medication of the nares, nasopharynx, Eustachian tubes, and fauces the prime consideration is not to irritate. If the surgeon cannot cure, he must, at least, be careful to make no worse. Arrest disease, benefit the hearing if possible, but be careful not to retard nor to make worse chronic catarrhal processes in the nose and ear. I must refer to purely rhinological sources for directions for treatment of posterior hypertrophies of the turbinated bones,



PLATE III.



Burnett's mounting of the Chevallier Jackson pneumatic masseur, fitted with the modified Siegle pneumatic otoscope.

With the latter instrument, in which the Siegle pneumatic speculum is operated by the air-pump, very gentle and excellent *periodic* pneumomassage can be applied to the membrana tympani and malleus, and mediately to the incus and stapes. Little or no blushing of the manubrial plexus takes place under the use of this instrument, if applied for only from thirty to forty seconds, and at a rate of two strokes of the piston a second. Good effects are obtainable in thirty seconds, as a rule, while its application for sixty seconds may be uncomfortable or even painful to the patient.

Either of the above-mentioned forms of rarefaction and condensation of the air in the external ear can be applied to *one ear at a time*, a great advantage over all forms of tympanic inflation excepting catheterization. In the employment of the various forms of gentle pneumomassage of the external auditory canal, the force is exercised directly upon the membrana tympani only. No sound is conveyed to the ear in this procedure, and therefore the auditory apparatus escapes the great dangers existing in all forms of phonomassage or vibromassage, which sooner or later impair the auditory nerve. In fact, they produce a form of "boiler-maker's deafness."

There are several forms of inflation of the tympana,—viz., the so-called air-douche, catheterization, Valsalvian autoinflation, and inflation by means of a nebulizer. All of these, excepting catheterization, are applied, whether desired or not, to both ears; nebulizer inflation has the advantage of conveying medicated air to the tympana. Valsalvian autoinflation has the very great disadvantage of producing congestion of the head and auditory apparatus in addition to other disadvantages accruing to the ears by its use. All forms of inflation possess the great disadvantage of being liable to force pathogenic matter from the nasopharynx into the naturally aseptic middle ear. This is especially true of the catheter, as in its passage, through the nares and nasopharynx it takes up septic matter from these cavities and conveys it at least to the mouth of the Eustachian tube, or takes up at the latter point septic matter and furthers its advance up the tube and to the drum-cavity as soon as the air-bag is blown into the catheter by the surgeon. All forms of inflation of the drum-cavity are more or less septic procedures, but catheterization is most so. It is fortunate that it is applied to only one Eustachian tube at a time. Nebulizer inflation is the least harmful, as it is very gentle, and is supposed always to convey an aseptic vapor to the Eustachian tube and middle ear when it inflates the latter.

Inflation of the tympana is rarely, if ever, needed; certainly not nearly as often as is generally supposed, because entire want of air in the drum-cavity is among the rarest of occurrences, on account of the so-called "safety-tube" formed by the under surface of the thick, sharply crooked cartilaginous roof of the Eustachian tube, as pointed out thirty years ago by Rüdinger, of Munich (pages 50, 51). This "safety-tube" in the

Eustachian tube prevents the occurrence of a vacuum in the drum-cavity and renders any form of inflation usually unnecessary. When inflation of the tympana is performed, it is more or less of a sudden shock to the middle ear, and especially to the nerve of hearing. The sudden entrance of air, *via* the Eustachian tube, into the tympanic cavity tends to force the membrana tympani and malleus outward and the incus, stapes, and membrane of the round window inward. Now, such a procedure is surely contraindicated when the stapes is already unduly impacted in the oval window, as in catarrhal processes in the drum-cavity. A force thus exerted upon the stapes and the round-window membrane at the same moment is especially prejudicial to the welfare of the auditory nerve in the labyrinth, because the recoil of the labyrinth fluid from the impaction of the stapes is prevented by the simultaneous inward pressure of the membrane of the round window by the inflation, and the usual yielding and compensatory function of this round-window membrane, in impaction of the stapes, is temporarily abrogated. Direct violence by compression may be thus offered to the labyrinth of both ears, whether normal or diseased, and it can readily be understood why inflation is usually disagreeable and sometimes painful to the patient, and also why tinnitus and vertigo are often made worse by it instead of being relieved.

Pneumatic Traction on the Tensor Tympani indicated in Chronic Catarrh of the Middle Ear.—The tensor tympani tendon is covered by a fibrous sheath, considered by Helmholtz to be a continuation of the periosteum lining the muscular canal in the bony portion of the Eustachian tube, from which it arises.

We can thus explain the early participation of this muscle and tendon in catarrhal and arthritic processes in the nasopharynx, Eustachian tube, and middle ear. Therefore, we can understand why one of the earliest symptoms of chronic catarrhal otitis media is contraction of this muscle and its tendon, with consequent retraction of the membrana tympani. With such retraction of the membrana tympani there are usually associated varying degrees of tinnitus aurium and impaired hearing, at first directly traceable, largely, if not entirely, to the retraction of the membrana and ossicles. Later on, if this retraction is not overcome, there are vascular changes in the ossicles and tympanic walls, with ankylosis of the ossicles and firmer impaction of the stapes in the oval window.

In such cases, in addition to treatment of the nasopharynx, it has been customary to inflate the tympana in various ways. But no form of inflation ever improves the hearing, relieves the tinnitus, and gives a sensation of openness to the ear equally as well, as agreeably, or as promptly as maintained rarefaction, or gentle, alternate rarefaction and condensation of the air in the external auditory canal by means of Siegle's pneumatic speculum applied to one ear at a time.

Pneumomassage applied to the external auditory canal and membrana tympani, and mediately to the ossicles of hearing, in both acute and

chronic catarrhal processes in the middle ear, is more efficient, less of a shock to the auditory nerve, more agreeable to the patient than inflation, and entirely free from sepsis, whereas inflation is not. Inflation of the tympana, being very rarely necessary as a means of forcing air into the middle ears, the latter being very seldom in need of it, it is fair to conclude that inflation of the tympana, as it must be applied to both ears, whether desired or not, is usually *contraindicated* in aural diseases.

On the other hand, as drawing the membrana tympani and malleus outward and traction on the tensor tympani and restoration of the normal isolation of the auditory ossicles are desired without any shock to the structures upon the inner wall of the drum-cavity, and as these can be so safely effected by pneumatic rarefaction of the air in the auditory canal, pneumomassage is indicated for these purposes. In fact, some form of pneumomassage of the external ear has almost entirely superseded the use of all forms of inflation of the tympanum in my hands for the past ten years.

Excellent results are often produced by gentle treatment of chronic catarrhal otitis media as outlined above, continued two or three times weekly for several months, whereas under vigorous treatment by strong sprays, *phonomassage*, and numerous inflations of and local applications to the nasopharynx and middle ear, all the symptoms—tinnitus, deafness, and vertigo—increase. In no case of chronic catarrh of the middle ear will applications to the external ear and membrana do anything but harm.

If, in spite of rational, conservative, non-irritant treatment of the nasopharynx, and gentle pneumomassage of the membrana, the ear symptoms grow worse, resort may be had to removal of the incus. The resultant overcoming of the retraction of the chain of ossicles, and consequent liberation of the stapes, will be followed by diminution and final cessation of the tinnitus and vertigo, and in some cases by improved hearing.

Tympanotomy and Removal of the Incus seem to arrest Progressive Hardness of Hearing.—It will be admitted by all aurists that one of the earliest events in chronic progressive deafness is retraction of the membrana tympani and the chain of auditory ossicles, with consequent compression of the labyrinth-fluid. This retraction of the conductors and compression of the labyrinth-fluid do not reach their height at once, but by degrees, and hence the gradual onset of the typical aural symptoms, tinnitus, dulness of hearing, and vertigo arising from the progressive physical changes in the drum-cavity. As the physical changes in the conductors increase and become permanent, organic changes occur in the labyrinth. It is admitted that loss of hearing in such cases is first due to impaired mobility of the stapes and the increased intralabyrinth pressure induced by impaction of the stapes. All operations and manœuvres for the relief of chronic catarrhal deafness have in view liberation of the stapes and diminution of intralabyrinth pressure. The retardation of

this progressive loss of function and the restoration of hearing while the pathologic changes are limited to the drum-cavity have ever been and are still the greatest tasks of aurists. The aurist knows only too well that his chances of arresting and curing progressive hardness of hearing exist only while the disease is limited to the drum-cavity. No treatment can overcome organic changes in the labyrinth.

When excision of the entire membrana tympani with the malleus and incus was first proposed as a means of relief in chronic catarrhal deafness, one of the first questions asked about its effects was whether it would check the progress of the deafness even if it did not improve the hearing. Pretty soon a negative answer was given to this question. In fact, it neither permanently improved the hearing nor checked its progressive loss, as it was always followed by inflammatory reaction. About eight years ago I substituted tympanotomy and removal of the incus only (the membrana, malleus, and stapes being left *in situ*) for total excision of the membrana tympani for the relief of chronic catarrhal deafness, tinnitus, and vertigo. This operation—far more difficult than total excision of the membrana and removal of the ossicles—is, according to my experience, unattended with reaction, improves the hearing to some extent in a few cases, does not make it worse in any, and relieves the tinnitus and vertigo when dependent upon catarrhal retraction of the membrana and impaction of the stapes. These results of the removal of only the incus became manifest at once, but whether or not this operation would have a deterrent effect on the progress of the deafness in the ear operated upon, and perhaps by synergy upon the opposite ear, could not be answered at once.

The number of cases of progressive hardness of hearing I have operated upon by tympanotomy and removal of the incus up to the present time is sixty-one. Most of these patients heard but very little at the time they were operated upon. Little or no improvement in hearing took place, but none have been made worse, and this latter fact is the most important one established regarding the hearing in most cases. In fact, the operations have been performed chiefly with the expectation of relieving tinnitus and ear-vertigo rather than the deafness, so advanced has the latter been. Tinnitus and vertigo have been relieved or banished in all cases; the hearing has remained unaltered or slightly improved in all cases. It would seem, therefore, to at least check the progress of the deafness. I have already stated elsewhere¹ that the cessation of tinnitus and vertigo may not be complete and permanent for six months after the removal of the incus and liberation of the stapes. After the lapse of six years since tympanotomy and the removal of the incus in one case of not profound deafness that I have observed at times ever since the operation, I am now able to report that in his case the removal of the incus

¹ Pennsylvania Medical Magazine, February, 1898.

has had a deterrent effect upon the progressive hardness of hearing, not only in the ear from which the incus was taken in December, 1892, but apparently upon the other ear not operated upon. The good result in this instance I attribute to the fact that I operated before the hearing had sunk to less than a foot.

I think that the course to be pursued in cases of progressive hardness of hearing will be one that will arrest progress rather than one that can restore lost hearing. The latter object is apparently unattainable after the hearing has sunk to half its normal quantity.

Let us suppose normal hearing to be represented by 100, and let us imagine that a case of progressive hardness of hearing presents itself, with a hearing distance of 50 in one ear and a hearing distance of 75 in the other ear. Every aurist knows that the tendency of such a case is to fall in hearing to zero, or very near it, in both ears. It is to be hoped that it can soon be demonstrated that to remove only the incus from the deafer ear, through an incision in the posterior segment of the membrana tympani, the latter, the malleus, and the stapes being left in normal position, though it may cause the ear operated upon to fall to 20 or 25 in the hypothetical scale of hearing, will arrest the deafness at that point, and by synergy prevent the other ear from progressing farther into deafness. It would seem that the mistake of aural surgeons has been in trying to restore *lost* hearing in such cases, instead of devising methods of arresting progressive deafness. We should operate while there is hearing to save.

Chronic Ear-Vertigo: Its Mechanism and Surgical Treatment.—Chronic ear-vertigo, sometimes called Ménière's disease, consisting in paroxysmal attacks of vertigo, is due to chronic catarrhal disease in the tympanic cavity. This latter malady tends to sclerosis of the mucous membrane of the cavity, rigidity of the membrane of the round window, retraction and stiffening of the ossicles of hearing, and a consequent impaction of the stapes in the oval window of the vestibule. This latter event, by pressure upon the labyrinth-fluid and consequent compression of the endolymph about the nerve terminals in the ampullæ of the semicircular canals, leads to the reflex phenomenon termed ear-vertigo.

In order to understand the mechanism of ear-vertigo, one must recall the anatomy of the middle and internal ears.

1. *The Labyrinth-Fluid.*—The labyrinth-fluid is composed of two systems,—viz., the endolymph, that which fills the interior of the membranous labyrinth, and the perilymph, filling the cavity of the bony labyrinth in which the membranous labyrinth is suspended. The endolymph, according to Hasse, of Würzburg, comes from an epicerebral lymph-cavity, being conveyed by the so-called aquæductus vestibuli to the cavity of the membranous labyrinth (Fig. 75, 4). Every increased or diminished pressure in the cerebrospinal fluid in the subarachnoid cavity will make itself felt through the aquæductus vestibuli in the in-

terior of the membranous labyrinth. The same authority shows that the perilymph is poured into the labyrinth from the subarachnoid space through the foramina acustica, and leaves the labyrinth by means of the aquæductus cochleæ (Fig. 75, 3). In fact, the perilymphatic cavity is inserted into the lymphatic tract of all vertebrates; and, being in connection with the subarachnoid space, it is seen how changes of any kind in the cerebrospinal fluid can be communicated to the perilymph and thence to the various parts of the membranous labyrinth. Especially can we understand how easily intralabyrinth-fluid pressure may be increased either from the cranial side through the aqueducts or the tympanic side through impaction of the stapes in the oval window, the semicircular canals thus irritated, and vertigo ensue.

FIG. 75.



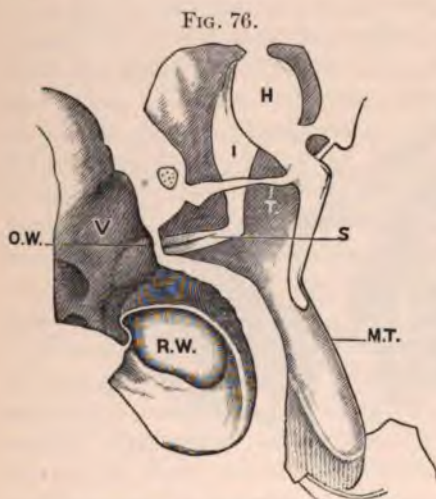
Cast of the left temporal bone after corrosion of the osseous tissue; the pneumatic cells cover the entire labyrinth excepting at the outer ends of the aqueducts, the internal auditory canal, and the upper curve of the superior semicircular canal. (Siebenmann.) 1, superior semicircular canal; 2, internal auditory meatus; entrance of auditory nerve; 3, aquæductus cochleæ; 4, aquæductus vestibuli.

If in a properly prepared normal auditory apparatus in a cadaver sound is conveyed from an organ-pipe into the external ear, the vibrations of the membrana, ossicles, and round-window membrane can be seen and measured, as I have shown in my physiological acoustic experiments in Helmholtz's laboratory in 1871-72. If the auditory apparatus has been so prepared as to enable the experimenter to convey water to the labyrinth from the side of the cranial cavity and thus increase the intralabyrinth pressure, while the sound vibrations of the ossicles and round-window membrane are going on, he will soon perceive that the intralabyrinth distention or engorgement thus brought about by the introduction of water into the internal ear will force the stapes and round-

window membrane tightly outward and cause their vibrations to cease, while the vibrations of the membrana, malleus, and incus continue. Thus an idea may be gained of what takes place in an engorgement of the internal ear from influx of lymph from the cranial cavity, or from congestion of the former. This outward fixation of the stapes in such instances might be less if the bonelet were not pushed outward against the incus and its fixation thus further augmented. Outward distention of the round-window membrane could be overcome by puncturing it; but this I have never done.

2. *Rôle of the Middle and Internal Ears in the Mechanism of Ear-Vertigo.*—My meaning as to the mechanism of chronic ear-vertigo may be made clearer by a consideration of Fig. 76. Thus, if the stapes S is impacted into the oval window O.W., its foot-plate will press upon the

fluid in the vestibule V, and if a recoil from this pressure cannot be obtained by the bulging of the membrane of the round window R.W. towards the tympanic cavity, the lymph in V, as well as in the entire labyrinth, is unduly compressed, the semicircular canals irritated, and ear-vertigo results. Or, if in any sudden and copious influx of lymph from the cranial cavity into the labyrinth, or in an increased vascularity of the labyrinth, a compensating recoil from such intralabyrinth pressure cannot be obtained at R.W., and also at S, as in a normal ear, the semicircular canals are unduly compressed and ear-vertigo is evoked. As is well known, both of these recoil points in the fenestræ become more or less unyielding in the later stages of chronic catarrh of the middle



Partly diagrammatic vertical section of the left auditory apparatus, in front of malleus and oval window, running through the vestibule and promontory, and viewed from in front. (Modified from Siebenmann.) H, hammer; I, incus; S, stapes; M.T., membrana tympani; V, vestibule; O.W., oval window; R.W., round window; T, tendon of the tensor tympani.

ear, when paroxysms of ear-vertigo are likely to be added to the already profound deafness and tinnitus.

Symptoms.—As the great majority of cases of chronic ear-vertigo occur in chronic sclerotic otitis media, let us first consider the symptoms of ear-vertigo as they occur in this form of tympanic disease. Usually only one ear (the worse) is the cause of ear-vertigo, though both ears may be affected with so-called chronic catarrhal otitis media. The more affected ear (the one causing the ear-vertigo) is *always profoundly deaf*, and may

be the seat of distressing tinnitus. In any case chronic ear-vertigo is (chronologically) the last among the lesions of chronic catarrh of the middle ear. It is manifest from this that the internal ear can lose its hearing function before its equilibrating function. In an ordinary case of ear-vertigo from chronic tympanic catarrh, the patient in the first attack is seized with a sudden and to him unaccountable vertigo, usually attended with an increase of tinnitus in the implicated ear. The attack may last from a few minutes to half an hour. The patient may be obliged to take hold of something for support, or to sit or lie down. Nausea may be present in the early attacks if the vertigo continues as long as fifteen minutes, but, as a rule, nausea and vomiting do not occur in the first paroxysms of this disease. When the seizures become more frequent, more severe, and longer in duration, nausea and vomiting may be very intense, and result in a form of collapse with pallid face and clammy surface, but without *loss of consciousness*. The fact that the patient does not lose consciousness from ear-vertigo serves as the great differential guide in diagnosis between ear-vertigo and apoplexy and epilepsy, with both of which it is often confounded at first. The apparent motion in ear-vertigo is generally towards the affected ear, in which direction the patient tends to fall. When both ears are the cause of ear-vertigo, the patient is entirely unable to walk, and sits down whenever he is attacked, even in the street. These phenomena have been termed Ménière's symptoms or disease.

The first attack of ear-vertigo is usually comparatively light, and generally attributed to stomachic derangement and treated as such. This first attack may not be followed by another for weeks or even months. Then a more severe attack comes on, which is followed in a week or two by another. At last the attacks may occur every week or every day. The patient now fears to leave the house, unless accompanied by an attendant, and is forced by this quasi-agoraphobia to give up any regular duties outside of his house. Even in such cases the true cause of the ear-vertigo is usually overlooked and the symptoms attributed to other influences. As the diagnosis is defective, the treatment not only does no good, but rather harm, if depletive, as it often is when "biliousness" or "apoplexy" is deemed causative of the vertigo. Finally, something draws attention to the ear as a possible factor in the production of the vertigo. Examination now reveals the fact that the patient is a victim of chronic ear-vertigo, most commonly of that form found in the late stages of chronic sclerotic otitis media. Deafness and tinnitus are found to have been present for a long time, to which within a few months, or even a year, there has been added the most distressing symptom of all,—viz., a tendency to frequent attacks of ear-vertigo. These may be so severe and so frequent as to keep the patient, especially if a woman, in bed for weeks at a time. If the patient be a man, he is rendered unfit for leaving the house alone and attending to his daily vocation. He be-

comes low-spirited, his general health fails, and his will-power becomes impaired. If the patient persists in leaving the house and in trying to work, he is liable to be attacked at any time by severe vertigo, nausea, and vomiting, his face becoming very pale and bathed in clammy sweat. At this point he will reel and fall if not supported, but there will be no loss of consciousness. He becomes helpless and must be carried home. I recall a case of this nature in which the patient, a man of forty, was attacked while "on 'change," and was brought in semi-collapse in a carriage to my office for relief.

Membrana Tympani.—If the membrana tympani of a patient affected with chronic catarrhal ear-vertigo be examined, it will be found to present the usual appearance of the drum-head in chronic catarrhal deafness,—viz., opacity, thickening, and retraction. The retraction of the membrana is so great as to draw the malleus upward and backward, carrying the membrana with it. In most of such cases the incudo-stapedial joint can be seen through the upper posterior quadrant of the drum-membrane. The examiner then *sees* in the retraction of the membrane and ossicles the *mechanical cause of the ear-vertigo*. The retracted chain of bonelets, by pressing the stapes inward into the oval window and holding it there in a condition of undue retraction upon the vestibule and its fluid, compromises the latter space and compresses the labyrinth-fluid upon the ampullar nerves in the semicircular canals, and ear-vertigo is evoked.

Ear-vertigo is not constant, however, because varying conditions of relieved tension in the middle ear and the chain of ossicles on the outer side of the stapes, and also similar variations in the labyrinth-lymph on the inner surface of the stapes foot-plate in the oval window, suspend temporarily the compression of the ampullar nerves, and the patient is temporarily free from vertigo.

The stapes, however, being permanently in a state of undue impaction in the oval window, it requires but little additional inward pressure of the stapes from the tympanic side or increased flow of lymph into the labyrinth to exert undue compression of the endolymph in the already compromised labyrinth space and irritative pressure upon the ampullar nerves, followed by an attack of ear-vertigo. Varying conditions in the health and circulation of the lymph or blood of the patient are sufficient to evoke these attacks in one in whom the drum-cavity is already diseased and the labyrinth space compromised,—i.e., contracted by the chronic impaction of the foot-plate of the stapes in the oval window. In a normal state undue inward pressure of the stapes into the oval window is compensated by a yielding of the round-window membrane towards the drum-cavity. In a normal auditory apparatus any undue increase in the flow of lymph towards the labyrinth, including, of course, the vestibule, is compensated by the recession of the stapes outward towards the tympanic cavity and probably by a similar recession on the part of the membrane of the round window. But if the stapes in the oval window and the

membrane of the round window are rendered abnormally rigid, as they often are by chronic catarrhal otitis media, compensatory recession at these two points to intralabyrinth pressure is impeded, the intralabyrinth space is thus easily engorged by an inflow of lymph or by increased vascularity, its fluid is compressed upon the ampullæ, and ear-vertigo is produced in a purely mechanical way, depending largely upon retraction of the tensor tympani and the ossicles in chronic catarrhal otitis media.

Ear-Vertigo in Chronic Purulent Otitis Media.—Ear-vertigo sometimes occurs in the subjects of chronic purulent otitis media. In these cases, too, the retraction and impaction of the stapes by the superposed and enlarged malleus and incus usually play the chief part in producing vertigo, for the malleus and incus in such cases are often covered with swollen and granulating mucous membrane, and bound firmly by synechiæ to each other and the inner tympanic wall and thus are made to press very forcibly upon the stapes. In these suppurative cases the blood-vessels of the mucous membrane of the drum-cavity are always deeply engorged, and as these vessels are intimately connected with the blood-vessels of the labyrinth, it is easy to see how the latter may become unduly engorged and excessive intralabyrinth pressure thus induced, resulting in ear-vertigo. Irritation and engorgement of the labyrinth, with resultant vertigo and nystagmus, in purulent otitis may also be due to direct transmission of inflammation through a carious opening from the drum-cavity into the horizontal semicircular canal or at some other point in the outer wall of the labyrinth. Though the mode of production of the ear-vertigo in such cases is somewhat different from that in chronic catarrhal otitis, the mechanism is the same,—viz., a mechanical pressure compromising the labyrinth space and compressing the ampullar nerves in the semicircular canals.

Treatment.—The cause of chronic ear-vertigo being a mechanical one, consisting chiefly in impaction of the stapes in the oval window, removal of this retractive force and liberation of the stapes should cure the disease. Consequently, many years ago I devised an operation consisting in surgical removal of the incus in cases of ear-vertigo originating from chronic catarrhal otitis. The removal of the incus breaks the retractive force of the tensor tympani and malleus exerted through the incus upon the stapes, and the latter bonelet is liberated.

In chronic purulent cases it is necessary to excise the remnants of the diseased membrana and the malleus and incus, with their synechial bands, in order to liberate the stapes. This operation in such cases, supplemented by local treatment of the purulent drum-cavity, is followed by cessation of the vertiginous attacks and cure of the chronic purulency. Thus, excision of the diseased ossicles in such cases leads to curing the chronic purulency and acts as a *prophylaxis of antrum and mastoid disease*.

Operation.—The patient is etherized (local anæsthesia by cocaine being both inefficient and toxic, according to my experience) and the external

auditory canal and the membrana sterilized by a solution of mercuric bichloride (1 to 5000) or one of formalin (1 to 1000). Then the auditory canal and membrana tympani are illuminated by means of an electric light held on the forehead and run by a small portable storage battery, made for the purpose of clinical illumination (Fig. 55).

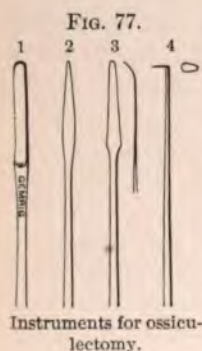
Where the membrana is intact, as it is in a case of chronic ear-vertigo due to chronic catarrhal otitis media, the initial incision is made with a delicate knife (Fig. 77, 2), beginning close behind the short process of the malleus and following closely the periphery backward and downward until reaching a point below the line drawn horizontally through the umbo of the membrana. This cut is followed by little or no bleeding, as a rule. The flap thus made should be pushed inward towards the promontory by means of a probe armed with a small dossil of sterilized cotton. If there is no bleeding, the incus-stapes joint is seen as soon as the flap of the membrana is pushed aside. If there is bleeding, it must be mopped away with sterilized mops on a cotton-holder.

The long limb of the incus being now in plain sight, it should be gently disarticulated from the stapes by drawing the former outward and downward by means of an incus hook-knife (Fig. 77, 4) passed behind it. When this is done the long limb of the incus should be grasped by special forceps (Fig. 74) and drawn very cautiously downward and outward into the auditory canal, and then removed entirely from the ear. When this is accomplished the operation is finished. The slight bleed-

ing that sometimes occurs in the chronic catarrhal cases requires no attention. The meatus should be stopped with sterilized cotton and the ear let alone for twenty-four or even forty-eight hours, unless the cotton in the meatus gets moist with blood or serum. If this occur the cotton should be removed and dry cotton inserted. There is to be no after-treatment in such cases, as all is accomplished when the incus is removed. As a rule, there is no reaction, and the wound in the membrana heals by first intention. Sometimes a slight reaction has occurred, shown by a little pain and some muco-purulent discharge; but this is healed in a few days by simply mopping the ear with sterilized cotton

and a solution of formalin (1 to 1000), and the inflammation has never had any bad effect upon the result of the removal of the incus in checking the vertiginous attacks. A serious reaction I have never encountered after the operation, neither in the chronic catarrhal nor in the chronic purulent class.

The mode of operation in the purulent cases is different from that in the chronic catarrhal cases with intact drum-membrane. In the former the membrana is already perforated and the ossicles, if still present, plainly visible in most instances. The incus should be detached and removed



first, and then the remnant of the diseased membrana and malleus should be completely excised. Hemorrhage in such cases is always relatively great, and delays the operation, as the field of operation requires constant and complete mopping before the surgeon can proceed. After the operation the ear requires syringing with a bichloride solution (1 to 5000), but the ear should not be stopped with cotton but allowed to discharge. The subsequent treatment must be that indicated in a case of chronic purulent otitis media. I have performed this operation in its two forms named above in twenty-seven cases of chronic ear-vertigo, mostly in *chronic catarrhal otitides*, and in no instance has it failed to give relief, and I know of no other kind of equally successful treatment of chronic aural vertigo (Ménière's disease). In two instances entire and prompt relief from ear-vertigo of over a year's duration *following mumps* has been afforded by the surgical removal of the incus as described above.

Pilocarpine gives no relief in genuine ear-vertigo due to changes primarily in the ossicles and the fenestræ in the middle ear. In fact, no drug can cure a true ear-vertigo originating in middle-ear disease that finally implicates the internal ear. Trousseau long ago pointed out the fact that vertigo *ab aure læsa* was of frequent occurrence; but he failed to relieve it by drugs. The only relief to be afforded in chronic ear-vertigo is by surgical liberation of the stapes; not by destruction of the internal ear, neither by large doses of quinine (Trousseau) nor by surgical means.

Pilocarpine injections in labyrinthitis are rarely of benefit. If no result is obtained after three or four injections, it is best to abandon this treatment. In deafness accompanying myxœdema the internal administration of *thyroid gland* has given good results (Cresswell Baber). *Pilocarpine* is contraindicated in functional diseases of the ear; therefore it is important to make a careful differential diagnosis between organic and functional diseases of the ear. If *pilocarpine* ever does good, it must be given in the early stages of an otitis interna. Inflations make the aural disease worse.

In syphilis of the ear, intranasal sprays of Van Swieten's solution have been employed by Rutten, and Délie and Gellé administered the iodides in wine, mixed with tannic acid to prevent intolerance. In all instances of chronic ear disease inflation will do harm by shock.

CHAPTER XVI.

ACUTE PURULENT OTITIS MEDIA.

ACUTE CATARRHAL OTITIS MEDIA, instead of undergoing resolution, may pass into acute purulent otitis media, induced by the passage of pathogenic germs from the nasopharynx into the middle ear.

Bacteriology.—It has been shown by the investigations of Löwenberg, Fränkel, Simmonds, Zaufal, and many others that genuine primary acute otitis media may be excited by the following germs: 1, the pneumococcus of Fränkel; 2, the streptococcus pyogenes; 3, the pyogenous staphylococci; 4, the pneumobacillus of Friedländer; 5, the bacillus pyocyaneus; 6, the meningococcus intracellularis of Weichselbaum-Jaeger (as in cases exhibiting this germ the aural suppuration was the primary disease from which the cerebrospinal meningitis originated); 7, the actinomyces. The chief producers, however, of primary acute otitides are the pneumococcus of Fränkel, the streptococci, and the staphylococci. The other germs occur only exceptionally.¹

Etiology of Acute Purulent Otitis Media.—Acute Bright's disease, diphtheria of the respiratory tract, polyarthritic rheumatism, tuberculosis of the lungs, pneumonia, traumatism of the nasopharynx (such as an operation for adenoids), influenza, the exanthemata, and, in fact, any form of inflammation of the nasopharynx may give rise to an acute purulent otitis media.

The acute purulent otitis of typhoid fever is due to the decomposition of secretions in the nasopharynx and the entrance of septic matter into the drum-cavity by way of the Eustachian tube, favored by the recumbency of the patient; not to any specific germ. In *influenza otitis*, according to Haug,² the epitympanic space (the attic) is the part chiefly affected. Tobeitz³ has shown that in measles, before the appearance of the exanthem, the mucous membrane of the Eustachian tube and middle ear, like that of the respiratory and digestive tracts and the conjunctiva, is independently affected; not by transmission from the catarrhal nasopharynx.

It does not seem possible to establish any pathologic differences between acute catarrhal and acute purulent otitis media, as the same microbes cause both conditions, and it is merely a question of resistance on the part of the organism, as well as of the wisdom displayed in the treatment of the primary symptoms, whether the acute catarrhal otitis media shall become a purulent otitis. Every case of acute coryzal inflammation of the Eu-

¹ E. Leutert, Arch. f. Ohrenh., July and September, 1899.

² Arch. f. Ohrenh., May, 1896.

³ Ann. f. Kinderheilk., 1887.

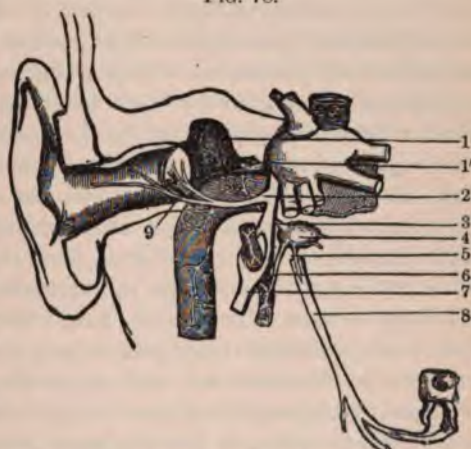
stachian tube and middle ear is potentially an acute purulent otitis media, and it depends upon the nature of the treatment of the nasopharynx and middle ear whether a purulent process shall be set up. If the treatment is irritative,—i.e., septic,—purulency of the ear will surely ensue, and in many cases with resultant mastoiditis, sinus-phlebitis, thrombosis, pyæmia, brain-abscess, and meningitis. None of these serious and often fatal results are necessary sequels of acute otitis media. They are invariably artificial products of improper treatment of the primary inflammation in the nares and middle ear.

Acute Tuberculosis of the Middle Ear.—Acute tuberculosis may occur in a previously healthy ear. In such a case pus from the ear may contain Koch's tubercle bacillus. Primary tuberculous disease of the middle ear is much more frequent than is usually supposed to be the case, as shown by Milligan.¹ Tuberculous disease of the middle ear is caused by the entrance of disease germs from the tuberculous nasopharynx, through the Eustachian tube, into the tympanic cavity. How ill-advised, therefore, are all forms of inflation of the drum-cavities in tuberculous subjects!

On account of the anatomical relations of the middle ear, and the grave results of disease of this part of the body, especially in children, this organ becomes of great importance to all practitioners of medicine; yet there is no part of the human body so little understood by most physicians.

The reflex action concerned in the purulent otitis media of teething deserves our consideration. "A considerable portion of the blood-supply of the membrana tympani is derived from an artery that leaves the internal carotid in the carotid canal, and proceeds by a very short course directly to its destination. Being thus closely connected with a large arterial trunk, this small tympanal branch [Fig. 78, 9] of the internal carotid artery possesses very favorable circumstances for a speedy augmentation of its blood-supply. Now, the nervi vasorum constituting the

FIG. 78.



Nervous connection between the teeth and the ear. (Woakes.) 1', 1, tympanic cavity 2, auricular branch of auriculo-temporal nerve; 3, branch from the ganglion furnishing vascular nerves to the internal carotid artery and its branch the tympanic artery; 4, otic ganglion; 5, branch from otic ganglion joining inferior dental nerve; 6, middle meningeal artery; 7, auriculo-temporal nerve; 8, inferior dental nerve to teeth and gums; 9, short tympanic branch of internal carotid artery.

¹ Brit. Med. Journ., November 16, 1895.

carotid plexus at this part of its course come largely from the otic ganglion [Fig. 78, 3]. The third branch of the fifth nerve is cut through in the diagram to show this ganglion. On the other hand, the inferior dental nerve [Fig. 78, 8] supplying the decayed tooth or gums, as the case may be, also communicates with this ganglion [Fig. 78, 4, 5]. We thus arrive at a direct channel of nerve-communication, through the otic ganglion, between the source of irritation, the tooth, and the vascular supply of the drum-head. The effect, then, of the irritating impression proceeding from the decayed tooth or swollen gums will be to excite waves of vessel-dilatation in the correlated area, the drum-head. Its vessels now become largely distended, acute congestion is thus established, with its attendant stretching of the sensitive and tense tissue in which it occurs, and so occasions the pain experienced by the subject of these conditions. If the irritation be sufficiently prolonged, effusion into the tissues ensues, which under favorable circumstances will pass into suppuration and constitute a true otorrhœa. Owing to the free inosculation of the vessels of the drum-head with those supplying the tympanic cavity, it will not be long ere this region participates in the inflammatory process, so that this cavity may also become filled with pus or muco-purulent fluid" (Woakes). Of course this accumulation must either escape by the Eustachian tube, as it can in very young children, from the comparatively large size of this tube in them, or it ruptures the membrana and runs out at the external auditory meatus. Before discharge takes place from the drum-cavity, the pent-up matter may press upon the fenestræ and thence upon the contents of the inner ear, and excite convulsions.

Before suppuration ensues in the drum-cavity, inflammation may extend from the drum to the meninges of the brain, by the way of the petrosquamosal suture, through which a fold of dura mater dips into the tympanic cavity and unites with the muco-periosteal lining of the latter. This fissure is wide and the portion of dura mater entering the tympanum through it is large in infancy. Towards adult life this fissure becomes narrowed or obliterated, but the vascular connection between the drum-cavity and the brain continues.

Symptoms.—In acute purulent otitis media the pain becomes more intense, the hearing dull, tinnitus louder and distressing, and fever usually sets in if it be not already present from other causes. The membrana tympani will be found congested and its features lost in the general swelling of its surface as the inflammation within the drum-cavity advances.

Treatment.—In this form of otitis, as in the acute catarrhal form, dry heat about the ear will be most efficient in allaying the pains, and sometimes in causing resolution. Warm water or warmed watery solutions of carbolic acid (1 to 40) may be tried, but, as has been said, may afford little or no relief, though the latter sterilizes the auditory canal and prepares it for either a spontaneous or artificial perforation of the drum-membrane.

Inflations, aspirations, etc., must be carefully avoided now, as in the acute catarrhal form, for fear of forcing the pathogenic germs from the middle ear into the antrum and mastoid cells. In fact, in this way the large number of cases of so-called acute mastoiditis consecutive to acute otitis media are caused,—*i.e.*, they are artificial, not necessary results of the otitis media. In such cases the nasopharynx may be sprayed, not syringed, with Dobell's solution, if the nares are filled with tough secretions; not otherwise. Ordinary gentle blowing of the nose will be quite sufficient to clear the nostrils. Under the above conservative treatment the earache usually ceases in a few days, either with or without spontaneous rupture.

If pain continues over six hours in a child, or twelve hours in an adult, without spontaneous rupture of the membrana tympani, paracentesis of the membrane should be performed, because not only hearing, but life itself may be at stake in many cases if the drum-membrane is not opened in some way. As the inflammation advances the membrana tympani will be seen to bulge, especially in its posterior half. Sometimes, however, the most prominent portion is in the membrana flaccida. As the inflammation in the drum-cavity increases the pain becomes more intense, children being thrown into convulsions in some instances, and adults made to writhe and scream with pain. After secretion forms in the drum-cavity and the membrana bulges, no relief can be obtained until the pus escapes by either a spontaneous or an artificial opening in the drum-membrane. In time, a spontaneous opening will occur; but, as the tendency is for secretion inside the drum-cavity to inspissate, the longer perforation is deferred the less likely it is to occur spontaneously, and then the retained secretions will burrow towards the meninges, sinuses, and brain-cavity, especially in children. Hence the vital indication is prompt paracentesis in a case of acute otitis media with the membrana still imperforate after a few hours of great pain followed by bulging of any part of the membrane.

Having sterilized the auditory canal and membrana tympani and illuminated these parts by means of the ordinary forehead-mirror, if the patient is not etherized, an incision must be made in the most prominent part of the membrana. If the patient is etherized, an electric head-lamp (Fig. 55) must be employed, as an open flame must not be brought near the patient. If daylight can be used, no artificial light is needed. For performing paracentesis, or, rather, for incision of the membrana, a knife like that shown in Fig. 79 may be employed. Some prefer a knife the shaft of which is set at an angle to the handle, like the one in the illustration, while others prefer, for all operations on the membrana, a straight instrument. An incision from one to two millimetres, or even three millimetres, long is far preferable to a mere puncture with the so-called paracentesis-needle, as such an opening is not sufficient for drainage. Recovery ensues sooner in cases in which paracentesis has been performed than in those in which the perforation is spontaneous.

In a case of earache with congested and bulging drum-membrane the surgeon must be careful to differentiate between simple swelling of the

FIG. 79.



Paracentesis-knife.

outer surface of the membrana as it occurs in so-called myringo-dermatitis and bulging of the membrana from the outward pressure of secretions on its inner surface. In the former the prominence is generally more punctate and sharply defined, often being, in fact, a yellowish, brownish, or livid bulla. In otitis media the protrusion from retained secretions comprehends more of the surface of the membrana, especially in its lower and posterior portions.

In both forms of acute otitis media the condition of the membrana tympani must be watched carefully and constantly throughout the progress of the disease, because only by an intelligent observation of its varying conditions can its treatment be properly conducted.

After either spontaneous or artificial perforation of the membrana there is usually a free discharge of muco-pus and a cessation of pain, especially after prompt spontaneous opening of the membrane. If this

has not occurred and paracentesis has been obligatory, the inspissated secretions escape more slowly at first and the pain gradually diminishes. After any form of perforation of the membrana in acute otitis media a discharge must be regarded as beneficial, as it carries off pathogenic germs. Therefore little or no local treatment of the ear should be applied for fear of secondary irritation of the outer ear and perforation of the membrana. If this latter condition is established, the escape of secretion from the middle ear is prevented, secondary infection of this cavity ensues, and chronicity of the purulency is imminent with mastoid complications. Hence the outflow of pus from the acutely inflamed ear must be favored. The ear should not be syringed at all at such a time, unless the discharge is very thick and not escaping readily. In acute cases, for reasons already given, the time to syringe the ear is before discharge sets in, and not afterwards, for fear of secondary irritation of the perforated membrana and infection of the drum-cavity (page 161).

In any case of acute purulent discharge, once in twenty-four hours is

quite often enough to syringe the ear, if, indeed, it is ever necessary. Let the ear run and drain itself through the natural drainage-tube, the external auditory canal. Keep the concha and meatus greased with cosmoline to prevent chapping, and mop with sterilized cotton or gauze as they become filled with secretions, but do not swab them. At the same time all forms of inflation, aspiration, and syringing of the nares and nasopharynx must be avoided. Under these conservative and rational procedures the ear will, in most instances, return to its normal condition in the course of two or three weeks.

I have never seen acute mastoiditis consecutive to acute otitis media in a case in which I have treated the primary otitis media from the outset. Therefore I am forced to conclude that when acute mastoiditis follows close upon acute otitis media it is purely an artificial result of improper treatment, not of neglect of the primary otitis. In fact, total neglect is better than improper treatment. Usually the secondary infection of the acutely inflamed ear and mastoid is due to the treatment applied by the patient, though in some instances by the physician, especially if he uses hydrogen dioxide or excessive syringing, or both.

Of course, the general health and strength must be regarded and improved in this as in all forms of otitis media. The nares and nasopharynx may demand either moderate spraying with Dobell's solution once or twice in twenty-four hours, or with fluid cosmoline in which a few minims of eucalyptol or a grain or two of menthol are suspended. Oily as well as watery sprays should be used sparingly, three puffs of the atomizer in each nostril being sufficient at an application.

The local treatment of an inflamed ear, in any stage of any form, must be left entirely to the physician. It cannot be carried out by nurses or parents with any probability of benefit.

The physician must examine the ear, cleanse it, and then apply the treatment indicated by *what he sees* in the ear after it is cleaned and inspected by himself. If he can interpret what he sees by inspecting the auditory canal and membrana tympani, he will know what to apply or whether to abstain from applying anything to the drum-membrane. If he cannot examine the membrana intelligently, he cannot apply anything as a remedy in a scientific way, and should refrain from treating the case. In no instance will instillations and powders either prescribed or applied by a physician in a haphazard way do any good, and syringing with *anything* has done more harm than good to inflamed ears. In acute otitis, after discharge sets in after either spontaneous or artificial perforation of the membrana, the less treatment the ear receives the sooner it will get well.

A Case of Acute Otitis Media caused by the Nasal Douche; Secondary Infection of the Middle Ear and Mastoid Cavity by Subsequent Improper Treatment; Operation and Relief.—The history of the causation of acute otitis media, and the evidences of secondary infection of the middle ear and

mastoid process by subsequent treatment, are so accurate and plain in this case that I deem it important for the reader to know them.

Briefly, the history is as follows. April 23, 1896, Rev. J. S., aged sixty, of Ohio, stated that on February 1 of that year he had a slight cold in his head, and was advised by a local physician to use the nasal douche to obtain relief. He felt at once a stopping up of his left ear, but was told to persevere with the nasal douche, though the ear soon began to ache, and by February 6 he was suffering with a fully developed inflammation of the left middle ear. The ear ached badly for a week, during which nothing rational was done for the disease, but the nasal douche was continued. Finally, spontaneous rupture of the membrana occurred and the intense earache ceased. Then his physician began a series of moppings, syringings, and instillations in the running ear, with counterirritation behind the ear over the mastoid, and the patient was directed to inflate his ears by the Valsalvian method. For over one month this treatment was kept up, the copious use of hydrogen dioxide solution for syringing and instillations comprising a large part of it. The ear was not very painful, but the discharge was copious, the mastoid grew sore and tender, and pain radiated from this region to the vertex.

The patient now went to another city to consult an aurist, who continued pretty much the same treatment, adding thereto insufflations of boric acid. The ear became worse and the general condition of the patient bad. He therefore removed to the home of a relative in another city, where the local physician continued the above-named infectious treatment with the addition of cocaine drops, though the ear continued to pour out copious streams of creamy pus, the mastoid pain and soreness increased, and the general nervous tone of the patient approached a low point.

Finally, I examined the patient, and found him pale and exhausted by pain and loss of sleep. His pulse and temperature, however, were normal; appetite fair and bowels constipated. There was still pain radiating from the mastoid to the vertex, which prevented sleep, and the mastoid was slightly swollen and a little tender on pressure. The membrana was largely perforated in the posterior half, and its outer surface, like that of the skin lining the auditory canal, was macerated and denuded of epithelium, but there were no granulations in the fundus of the canal nor on the membrana. Valsalva's inflation easily forced a current of pus from the drum-cavity.

The patient entered the Presbyterian Hospital, in Philadelphia, where all local treatment of the case was stopped, excepting drainage by means of a narrow strip of iodoform gauze, and the case observed for two days. At the end of this time the only change observed was increase of the mastoid swelling and tenderness. Therefore, on the 25th of April, the patient was etherized, and an incision made into the now tumid, red, and tender spot behind the auricle. The knife passed down to and through the

softened bone, and there was an escape of a little offensive pus. Upon further enlargement of the incision and inspection of the mastoid surface a spontaneous perforation, one-fourth of an inch in diameter, was found in the cortical surface of the mastoid. This was enlarged so as to admit a large curette, and about half a fluidounce of red, jelly-like pulp with admixture of pus was spooned out. The mastoid cavity proved to be one of the large bullous variety. The walls in all directions were easily felt with a probe and the latter was passed into the aditus and attic. No granulations nor denuded surfaces were felt anywhere. The outline of the lateral sinus was easily made out with the probe and curette. Freeing the mastoid cavity of this red pultaceous mass caused considerable hemorrhage, but this ceased when the cavity was emptied. Its inner surface was then felt to be perfectly smooth.

A drainage-tube three inches long was inserted, the upper edges of the incision were brought together by sutures of silkworm-gut, the wound dressed with iodoform gauze, and let alone for twenty-four hours. It was then found that the ear had ceased to run and the mastoid pain had stopped. The mastoid wound discharged only a little bloody serum. No pus came from the drainage-tube and the latter was shortened. The perforation in the membrane had closed. The wound was now dressed with sterilized gauze. On the third day after the operation the drainage-tube was entirely withdrawn and the wound dressed with an iodoform gauze patch, held in place with collodion. This was renewed every few days until June 1, when the mastoid wound had healed. The hearing was reduced to one foot for ordinary voice.

The first error in this case was the use of the nasal douche to relieve a cold in the head; that set up the acute otitis media.

The second error was to allow the ear to ache one week without performing paracentesis of the membrana tympani. This should have been done at the end of the first twenty-four hours of earache, and the ear gently stopped with antiseptic gauze, but not syringed nor touched with anything for fear of secondary infection.

The day must come when every man properly qualified to practise medicine will know when and how to perform paracentesis of the membrana tympani, just as he is now supposed to know what to do and how to do it in connection with an abscess elsewhere in the body. Until the general physician is thus qualified to treat an acutely inflamed middle ear, patients will continue to suffer pain, lose their hearing and sometimes their lives, through the deficiency in those to whom they have intrusted their physical welfare. However, in the case under consideration spontaneous rupture was awaited. Even then, had the running ear been gently stopped with some iodoform gauze, or carbolized gauze, which would have aided drainage of the middle ear, and then let alone, secondary infection of the middle ear and mastoid would not have ensued. I regard hydrogen dioxide as one of the worst substances that

can be inserted into the running ear in such cases, as by its expansive force it pushes pus into the mastoid cavities and sets up secondary infection therein. Nothing should be syringed or put in any way into the acutely discharging ear. The only time to put anything, and even then only a weak, unirritating antiseptic solution of carbolic acid (2.5 per cent.), into the acutely inflamed ear is before the discharge begins; for such treatment disinfects the auditory canal, frees it from the staphylococcus albus nearly always present in it, and thus renders less likely the invasion of the drum-cavity by this germ when either spontaneous rupture or paracentesis of the membrana tympani occurs.

Hence the third and great mistake in the treatment of this case after the discharge set in was the month or two of syringings, moppings, instillations, and insufflations which were directed to the running ear and open drum-cavity, and also the Valsalvian self-inflations of the tympanum on the part of the patient by his physician's orders.

Acute inflammation of the middle ear being caused by the entrance of streptococci and other germs into the drum-cavity from the nasopharynx, it is manifest that any form of inflation of the nasopharynx may force fresh germs from it into the middle ear, or force pathogenic germs already in the drum-cavity into the mastoid cells, which otherwise would escape acute infection.

The acute inflammation thus set up in the ear will generally run a self-limited course ending in a spontaneous rupture of the membrane, and discharge, which is beneficent, as it carries away the pathogenic germs. This current, therefore, should not be impeded in its escape, as it will be if secondary infection of the perforation and the middle ear takes place.

The staphylococcus albus is the acknowledged cause of secondary infection and chronicity in aural suppurations, and is generally present in the external ear, on the fingers of both patient and physician, and in most objects put into the ear. Therefore when the latter is the seat of an acute inflammation it is very easy to bring about secondary infection of the middle ear and mastoid cavity by *anything* put into the ear, by either the physician or the patient, after discharge sets in. In fact, all chronic cases of otorrhœa are thus produced, chiefly, as I believe, by the various "domestic remedies" applied by the patient. But the physician is sometimes to blame, though unconsciously, because the very substances and cotton mops he employs in the ear often contain or push in staphylococci, and cause the secondary invasion he is trying to ward off. Therefore nothing should be put into the acutely running ear but a strip of antiseptic gauze to promote drainage and the outflow of pus.

Fortunately, with the exception of paracentesis of the membrana tympani (not always demanded, however), the best treatment of acute otitis media is easy and simple, whereas the improper infectious treatment is comparatively difficult and vexatious to both patient and physician.

Mastoiditis with Spontaneous Perforation of the Medial Plate of the Process.—In some instances of mastoid empyema spontaneous perforation of the medial plate of the process occurs, and pus is poured into the digastric furrow of the bone beneath the insertion of the sternomastoid muscle. The pus thus liberated from the mastoid cells may find its way either forward along the tract of the digastric muscle, and point in the pharynx, or backward towards the nucha, but beneath the deep fascia of the neck in both instances. This form of acute mastoiditis, with spontaneous perforation of the medial plate of the process, when it takes place occurs in connection with an acute inflammation of the middle ear, and has been termed "Bezold's mastoiditis," because Bezold, of Munich, recently recalled professional attention to it. It was not unknown to the older surgeons.

Subfascial abscesses in the neck consecutive to acute inflammation in the tympanic and mastoid cavities are said to be not uncommon in Europe, Collinet¹ having based his thesis upon two hundred recently reported cases. Three ways of propagation of the otitic and mastoid supuration to the neck are recognized,—viz., by way of the veins, by way of the lymphatics, and by direct escape of the pus through a spontaneous opening in the medial plate of the mastoid process, beneath the insertion of the sternomastoid muscle. By this last-named way pus gets beneath the deep fascia of the neck and burrows either backward towards the nucha and the dorsal muscles, or forward, *via* the digastric groove and muscle, towards the pharynx, into which it may discharge itself; or it may burrow forward and downward in front of the sternomastoid muscle until arrested at the clavicle.

Consecutive abscesses in the neck, propagated thither by venous or glandular channels, are, as a rule, more superficial and restricted in their area, and hence less serious than the subfascial form. Cases of consecutive abscesses in the neck, from direct propagation through a spontaneous perforation in the medial plate of the acutely inflamed mastoid process, are the most serious, and therefore attract the most attention from the surgeon. After the pus has escaped spontaneously from the mastoid cavity to the deep tissues of the neck, the abscess shows no tendency to prompt spontaneous evacuation outwardly through the soft tissues of the neck, and, if left to itself, burrows farther and deeper inward, producing septicæmia and death, especially if the abscess discharges itself into the pharynx or lung.

Symptoms of Spontaneous Perforation of the Medial Plate of the Mastoid Process.—After pain has lasted for several days, or even weeks, in a case of acute otitis media, the pain in the ear and mastoid may suddenly diminish or cease entirely, the otorrhœa continuing nevertheless. The mastoid process may or may not have been entirely free from external symptoms; usually, however, it is free from objective symptoms in this

¹ Thèse de Paris, 1897.

form of mastoiditis and remains so. Within twenty-four hours of the cessation of pain in the ear and in the mastoid there will be noticed a brawny swelling *beneath* the mastoid process, extending sometimes both behind and in front of the insertion of the sternomastoid muscle, but generally only behind and below the process, with a tendency to extend below and backward towards the region of the splenius muscle. Pressure upon these brawny swellings beneath the mastoid may not be very painful, but by such pressure pus can be forced upward and inward through the spontaneous opening in the mastoid process, through the mastoid cells, antrum, and middle ear, and out into the external auditory canal. A patient in this condition usually shows pyæmic symptoms, and will require an operation for the free escape of pus now burrowing in the deep, soft tissues of the neck.

Treatment.—The mastoid process may have to be laid open and a counter-opening made in the neck at the most prominent part of the inframastoid tumefaction, whereupon recovery will ensue. In some cases only the counter-opening in the retromastoid swelling, without opening the mastoid bone, already spontaneously perforated, will be required, and speedy cessation of the aural and nuchal symptoms, with recovery of the hearing, will take place, just as occurs after prompt incision into an extramastoid suppuration consecutive to spontaneous opening of the mastoid cortex *behind* the ear.

In some cases of mastoiditis, with spontaneous perforation of the medial plate of the process, in which general mastoid symptoms—as pain, tenderness, swelling, redness, etc.—demand it, before the counter-opening is made in the neck to relieve the gravitation abscess, the outer mastoid cortex is to be opened, the cavity exposed, and the passage-way of the pus, through the medial plate of the process, and the direction of the sinus into the neck are to be sought with a probe, and a counter-opening in the neck made accordingly. If the counter-opening in the neck is made promptly,—*i.e.*, as soon as any symptoms of burrowing of pus in the neck-tissues show themselves,—quick recovery ensues. But delay in operating in such cases is generally followed by septicæmia and sometimes death.

The after-treatment of the wound-cavities in an uncomplicated case of Bezold's (medial plate) mastoiditis, with burrowing into the neck, is to be conducted on general antiseptic surgical principles.

I have found that in all cases of *spontaneous* perforation of the mastoid after acute empyema, with discharge of pus beneath the soft tissues, whether the simple form or the Bezold form of mastoiditis, after free incision in the soft parts and escape of pus, especially if fluid syringed either through the ear or through the wound escapes at the opposite end of the suppurating tract, healing takes place promptly under one daily syringing of the tract with a solution of bichloride (1 to 6000) without any trephination of the mastoid.

A Case of Faucial, Nasal, and Aural Diphtheria.—George Dorsey, three years old, was brought to the Presbyterian Hospital, January 18, 1898, with fractured femur and humerus, and with scalp wounds, having been struck by a locomotive. The shock was profound, but he reacted well and began to recover from his injuries.

On February 1, thirteen days after his admission to the hospital, the glands of his neck were found to be swollen, and he complained of a sore throat, but no patches were found in it. A culture was made from matter from his throat, by the Board of Health, giving a positive result. The patient was then placed in the isolation ward, February 5. At this time there was a slight, thin, purulent discharge from his nose and ears, but no cultures were made from these discharges. At the end of six days, all symptoms of faucial diphtheria having disappeared, and cultures from faucial matter proving negative, though the aural discharge continued, the patient was sent back to the Children's Ward, without cultures being made from the nose and ears. He remained well a week, when discharges began again from his nose, his temperature went up, and cultures from the nose, by J. D. Steele (bacteriologist of the hospital), February 17, were positive as to the presence of the Klebs-Löffler bacillus, streptococci, and staphylococci. The child was taken again to the isolation ward, where he passed through a mild attack of diphtheria, the temperature never being above 103° F. and the depression slight.

For two or three days there were exacerbations of temperature, with enlarged cervical glands and patches in his throat, all of which symptoms disappeared under treatment with antitoxin (500 units, Mulford), given late in the disease.

Almost from the first symptom of diphtheria there was a thin, purulent discharge from the ears, but no cultures were made from it until March 12, after the patient's recovery from the second attack of faucial diphtheria, when the Klebs-Löffler bacillus was found by culture to be in the aural discharge.

From February 17 to March 2 cultures made by Dr. Steele, from the nasal discharge, revealed the presence of diphtheria bacilli, but by March 3 the cultures from the nose were negative.

The discharge from both ears continuing, cultures were made from it on March 12, those only from the right ear proving positive. The same result was obtained again on the 13th of March. It was at this time that I was asked to see the case and prescribe for it. For the frequent syringings with hydrogen dioxide I substituted instillations of formalin (1 to 1000). These, after a few applications, were followed by disappearance of the diphtheria bacilli from the ear (negative culture March 16) and cessation of the aural discharge a few days later.

It becomes manifest that even if antitoxin caused disappearance of the diphtheria bacilli from the nose and throat, it did not expel them from the ear in this case. It is also probable that the second attack of diph-

theria of the fauces and nose, February 17, was due to autoreinfection (perhaps by the fingers of the child) of the nares and fauces from the ears, which still continued to discharge, and, as soon as cultures were made from the aural discharge, were shown to contain diphtheria bacilli, though cultures from the throat and nose had been shown to be negative. It would seem to be only prudent, therefore, in a case of diphtheria, with faucial, nasal, and aural discharges, to make cultures from all of these localities, and to consider the case still diphtheritic until cultures from all of these regions are negative; otherwise there may be reinfection of recovered territories from those still infected, as apparently occurred in this case.

It is also worthy of careful note that the diphtheria bacilli continued to appear in the aural discharge until formalin solution (1 to 1000) was substituted for the copious syringings with hydrogen dioxide.

The Ear in Acute and Chronic Bright's Disease.—There is a distinct and undoubted connection between aural disease and nephritis, as shown by the observations of J. Morf¹ and many others.

Affections of the *middle ear* in Bright's disease present themselves as inflammatory, inflammatory-hemorrhagic, and hemorrhagic. The ear may become affected in any stage of nephritis, though otitis generally follows an exacerbation of the kidney disease. The subsequent course of the aural lesion is directly influenced by that of the nephritis. Some French writers maintain that the ear on the side on which the facial œdema is most marked becomes affected. It is also said by Morf² that both the quantity and the quality of the discharge in chronic purulent otitis media are influenced by the œdema. Voss has declared that "in the late forms of scarlatinous otitis there is one variety that is more dependent upon the nephritis than on the scarlet fever itself." The connection, indeed, is so intimate that "the progress of the nephritis may be estimated by the course of the otitis."

In the purulent forms of ear disease in the first group there is a marked tendency to caries and necrosis of the surrounding bony walls. Inflammatory changes in the Eustachian tube and middle ears are often present at the beginning of a nephritis, and hemorrhages into the middle-ear cavities are frequent and abundant. I have observed that in such hemorrhagic cases epistaxis also exists.

The aural prognosis depends upon the nephritis; but the ear disease must be regarded as a complication of grave import, especially in the purulent forms. Hemorrhages from the ear in nephritis are usually soon followed by death. There must be a combination of aural and nephritic therapeutics, especially in the first group of nephritic ear affections.

Mastoid empyema, sinus thrombosis and pyæmia, cerebral and cerebellar abscess, meningismus or pseudomeningeal symptoms in children,

¹ Arch. of Otology, October, 1898.

² Loc. cit.

meningitis and facial paralysis, are among the complications of acute otitis media.

Facial Paralysis in Acute Otitis Media.—This symptom occurring* in acute otitis media may be relieved as soon as paracentesis of the membrana is performed and blood and pus escape from the ear. Many cases of facial paralysis said to be due to "cold," and treated as neuralgic, are in reality caused by acute otitis media, as is shown by the speedy disappearance of the facial paralysis upon relief of the otitis.

In some instances a simultaneous inflammation of the *facial, acoustic, and trigeminus nerves* occurs in connection with coryza and otitis media, and while the facial and trigeminus nerves may again become normal, the deafness sometimes remains permanent.

Facial paralysis of the so-called rheumatic variety will generally be found at least associated with acute otitis media, if not caused by it. In the opinion of most observers, every case of facial paralysis from "cold" is due to a simultaneous acute otitis media.

Voss¹ and others have relieved otitic facial paralysis of several months' duration by opening the mastoid and cleaning out the hyperæmic spongy tissue from the antrum.

Acute Empyema of the Mastoid.—As has already been said, acute mastoiditis consecutive to acute otitis media in a previously healthy ear is usually, perhaps always, the result of improper management of the primary otitic affection.

In every case of purulent otitis media there is, in all probability, an attendant empyema of the so-called mastoid antrum. It ought to be called the tympanic antrum, as it is really a part of the tympanic cavity. Sometimes the antrum communicates with the mastoid cells, and hence it has received the name of mastoid antrum. When this cavity participates in the tympanic inflammation, and becomes filled with secretion like the rest of the drum-cavity, it will clear itself as easily as the drum-cavity does after an opening occurs in the membrana tympani. This fortunate result in drainage is assured by a siphonic action which naturally sets in as soon as either spontaneous or artificial opening of the drum-membrane occurs and the outflowing current of secretion is established, as any one familiar with the regional anatomy of these parts must see upon reflection.

If, however, secondary infection of the perforation in the membrana and of the drum-cavity beyond takes place by an infectious treatment through the external ear, secondary infection of the antrum occurs, and the patient is then in the first stages of acute mastoiditis. If the antritis is not speedily relieved, the suppurative process may descend into the true mastoid cells, or inward towards the lateral sinus, or forward towards the tegmen tympani and thence into the middle cranial fossa.

¹ Arch. f. Ohrenh., November, 1895.

Sometimes all of these unfortunate lesions occur in the same case. My experience has been that, if an acute otitis media is treated properly from the outset, consecutive mastoiditis will not occur.

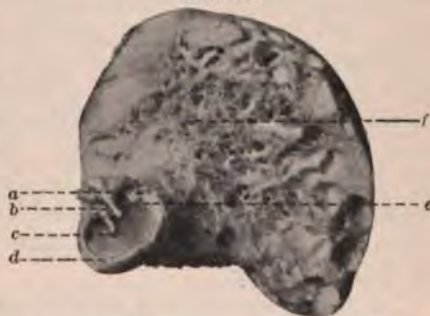
Regarding the etiology of acute mastoiditis consecutive to acute otitis media, I would say that, as I have never seen acute consecutive mastoiditis in a case I have treated from the outset of the acute otitis media, I cannot regard any case of acute consecutive mastoiditis as a necessary result. It seems to me to be due to the artificial secondary infection of the middle ear and mastoid cavity from excessive syringing, and especially the use of hydrogen dioxide, whereby pus is forced back into the middle ear, the aditus and mastoid antrum, and if a communication exist between the antrum and the mastoid cells, pus is forced into the latter, and then the surgeon is confronted with a mastoiditis of his own creation. In all cases of consecutive mastoiditis I have been called to see, hydrogen dioxide and excessive lavage had been employed. After either spontaneous or artificial perforation of the membrana tympani in an acute otitis media the ear should be allowed to drain itself through that most excellent natural drainage-tube, the external auditory canal. The more local treatment the acutely inflamed and running ear receives the more likely it is to become macerated, irritated, and blocked, and the discharge impeded. Then secondary infection of the ear and mastoid is imminent, and consecutive mastoiditis very likely to occur. After the acutely inflamed ear begins to discharge it should be allowed to run, as this running carries off pathogenic germs, and is, therefore, beneficial. The ear should be mopped dry with slightly singed cotton, the membrana inspected, and the extent and position of the perforation determined, if the latter has been a spontaneous one. Valuable knowledge may be gained by *early* inspection as to the condition of the auditory canal, especially over the region of the antrum. The concha should then be greased with carbolated cosmoline, and a small ball of sterilized absorbent cotton or gauze placed lightly in the concha, and let alone till the drainage tuft is wet; then the latter should be removed and a fresh one put in the concha (not in the meatus and canal). Syringing may be needed once in twenty-four hours, if at all, and should never be done by any one but an expert, and never forcibly. In numerous cases it is not required at all. If the outer surface of the membrana require medication, it can be done with a mop under illumination with the forehead-mirror. We should not endeavor to treat the acutely inflamed middle ear by forcing medicaments through the perforation into the cavity. We cannot easily do it, but if we should succeed we would do more harm than good. Under cautious, expert manipulation, as above outlined, acute otitis media will be well in a week or two, and the function of the ear normal. But if any other course is pursued, the patient may be under treatment a long time. There are many cases in which patients infect their own ears, sometimes by interference through the outer ears, and sometimes by Valsalvian autoinflation

of the tympana. But in such instances the patient and not the surgeon is to blame.

Symptoms.—Should the surgeon be confronted with mastoid empyema in the first or second week of an acute otitis media, he will generally find three prominent symptoms,—viz., pain, prolapse of the upper posterior wall of the canal near the membrana, and pyrexia. The pain is usually in the mastoid region, or on the same side of the head as the aural inflammation, and sometimes there is also earache, being either a continuance of the original earache or a return of it. There may or may not be tenderness on pressure upon the mastoid. If the latter occurs, it is said to be usually near the point of the mastoid process; but this is not so at first. As the acute mastoiditis is ushered in by acute antritis, if there is mastoid tenderness on pressure at this time, it is found over the region of the antrum,—i.e., high up and in the front part of the mastoid region close behind the auricle. If acute antritis has taken place and an incipient mastoiditis is before us, we shall find, in addition to pain in the mastoid, a prolapse or prominence of the skin of the upper posterior wall of the auditory canal, near the drum-membrane over the position of the antrum. If these two symptoms are present, the third one of the pathognomonic symptoms named above (fever) will also be observed in most instances.

Treatment.—The diagnosis of acute mastoid empyema or acute consecutive mastoiditis in a case of acute otitis media being established, the surgeon must proceed to open the antrum (Fig. 80). Many such cases go on to spontaneous rupture of the outer bony wall of the mastoid and entirely recover, like any other spontaneously evacuated abscess. But, considering the position of a mastoid empyema, so near the cranial cavity, it is not wise to wait many days for spontaneous opening, because there is an almost equal probability that such an escape of pus from the mastoid may take place on its inner rather than on its outer wall. Many cases of mastoid empyema are relieved by spontaneous rupture of the outer cortex, and doubtless many such occurrences are anticipated by a hurried mastoid trephination. But, with the three symptoms—pain, prolapse, and pyrexia—manifesting themselves in a given case, it is imperative on the surgeon to open the antrum. At such a point in the disease the mastoid skin-surface may present no ab-

FIG. 80.



Inner surface of membrana tympani, right side. a, incus; b, malleus; c, umbo at lower end of manubrium; d, annulus tympanicus; e, chorda tympani, passing forward between incus and malleus to Glaserian fissure; f, mastoid cells.

normal appearance, and the surgeon must operate on the indication of the three symptoms or of the pain only.

An incision down to the bone must be made close behind the insertion of the auricle, about a quarter of an inch from it, beginning close behind the temporal artery and following in a curve the insertion of the auricle to the mastoid tip below. The auricle must now be drawn forcibly forward and the region of the antrum sought (Fig. 11, *p*). If in this search a spontaneous opening in the bone has occurred, this opening may be enlarged with chisel and hammer by the surgeon, and the antrum sought and cleaned out. If there is no spontaneous opening in the bone, the surgeon must open it over the antrum with chisel and hammer, and work his way cautiously upward and forward.

In the adult's bone this opening should be of a funnel-shape, with its mouth directed outward. It should be about ten millimetres deep and from one to one and one-half centimetres wide. If the bone is not hyperostotic, as it rarely is in acute cases, such an opening as the above will generally expose the antrum. Great care must be exercised not to wound the facial canal as the surgeon approaches the aditus. In acute cases it is rarely necessary to enter as far as the aditus.

After a mastoid operation in acute cases Blake allows the wound cavity to fill with blood, thus hastening healing by first intention. The same method may be tried in chronic cases, excepting when in the chronic case the extent of the field of operation makes it necessary to resort to packing of the wound for other reasons.

The wound should not be irrigated, but simply lightly tamponed with iodoform gauze, if there is no parenchymatous hemorrhage; if the latter occur, the wound may be packed more firmly with iodoform gauze. Dressings should be changed in from one and a half to three days, according to the degree of moisture. At such a time any moisture in the wound should be mopped away with strips of sterilized gauze, and the auditory canal left open from the outset. As iodoform gauze hinders granulation, the later dressings should be simple sterilized gauze. Retention of pus may ensue in a mastoid wound if healing on the outer side is allowed before healing from the bottom takes place; yet long-continued tamponing delays healing.

Cerebellar abscess may result from acute purulent otitis media, especially if spontaneous rupture of the membrana does not occur promptly in a few hours, and paracentesis is delayed, as shown in a case reported by the author.¹

¹ Amer. Med. Assoc., Detroit, June 9, 1892.

CHAPTER XVII.

CHRONIC PURULENT OTITIS MEDIA.

Chronic Purulent Otitis Media.—This affection is due to the permanent lodgement of staphylococci in the acutely inflamed middle ear, and is usually caused by improper treatment of the acute otitis media, generally by the patient, but sometimes, it must be admitted, by the physician.

Symptoms.—The chief symptoms of uncomplicated chronic purulent otitis media are either hardness of hearing or profound deafness and a purulent discharge from the ear. There may also be tinnitus aurium, more or less constant, and occasional attacks of vertigo. In the debilitated and squalid there may be frequent attacks of earache and so-called "gatherings in the ear." The vibrating tuning-fork placed on the vertex may be heard quite well in the diseased ear if the labyrinth has not been invaded by the inflammation. Should the patient fail to hear the tuning-fork, by bone conduction, in the diseased ear, it would indicate that probably the chronic purulency had invaded the inner ear, and that the case all the more demanded prompt treatment to prevent still deeper advance of the disease.

The Discharge.—The discharge is usually more copious in children than in adults. In the latter the discharge is more likely to be copious the less chronic the disease. As the disease advances, the mucous membrane is either destroyed or so greatly altered in structure as to cease to throw off much secretion, and in such cases the discharge becomes thinner, more offensive, irritating, and suggestive of necrosed bone. In children the discharge is copious because of the usually attendant activity of the mucous membrane of the nares, nasopharynx, Eustachian tube, and middle ear. Hence in young patients the purulent discharge is mixed with strings of mucus, more or less transparent, from the Eustachian tube and tympanic cavity. The color of the discharge varies from a light yellow to a dark yellow or green, but there is no rule about this feature. It will be observed that the more copious discharges from the ears of young children are lighter in color than the scanty, which are usually quite dark. The slighter discharges of adults afflicted with chronic purulency in the middle ear are dark and more likely to form crusts in the meatus.

In most cases there seems to be a peculiar butyric odor to the discharges of chronic suppuration from the ear. This is largely due to a want of cleanliness. There will be very little odor in an ear thus diseased if it is kept clean and no necrotic bone is retained.

Minute perforations in the membrana are attended by slight and intermittent discharge. The chronic purulent inflammation in such cases is limited to the inner surface of the membrana tympani, near the perforation.

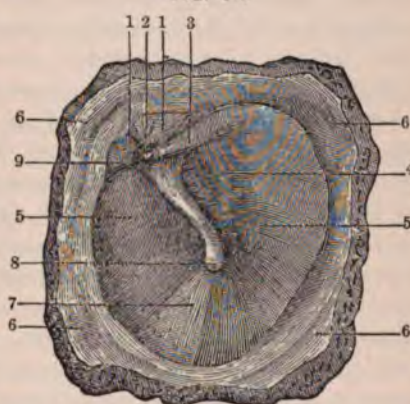
Appearances of the External Auditory Canal.—Inspection of the ear by means of the ear-mirror and the ear-funnel or speculum will reveal mucopus in and about the meatus and lying in the canal, more or less maceration of the skin of the auditory canal, and perforation or entire destruction of the membrana tympani, with inflammation of the mucous membrane beyond it in the drum-cavity. In order to obtain a good view of the external auditory canal and drum-head, the canal must be mopped dry with absorbent cotton on a cotton-holder, or syringed, and then it and the fundus of the canal and membrana gently mopped dry by means of a tuft of absorbent cotton on a cotton-holder. Syringing alone or mopping alone is rarely able to cleanse the ear sufficiently to allow of a good view of the diseased parts at the first examination. Inspection of the diseased ear after cleansing will reveal maceration of the cutaneous lining of the canal, and in very chronic cases one or more small exostoses, generally in the fundus of the passage near the annulus tympanicus. If the chronic discharge is not copious, the maceration of the skin in the auditory canal is not great. Instead of that, there are formed scales and crusts of hardened pus, mucus, and epidermis in the inner part of the auditory canal and on the outer surface of the upper part of the drum-membrane in the region of the membrana flaccida. In cases of copious discharge, the delicate skin lining the inner part of the bony auditory canal becomes more like mucous membrane than like skin, as it is denuded of epithelium and secretes a thin pus. This has led to the erroneous idea that the inner part of the auditory canal is normally lined with mucous membrane. This condition of the skin in the auditory canal is oftenest seen in those who have resorted to swabs of various sorts for cleaning their ears.

Appearances of the Drum-Head and the Tympanic Cavity.—Chronic purulent discharge from the tympanic cavity presupposes a perforation in the membrana tympani. Such a perforation may be at any point in the membrana, least frequently, however, in the flaccid part, the so-called Shrapnell's membrane. Let us first consider disease of the atrium or lower part of the drum-cavity, with perforation of the membrana tensa, the part below the folds of the drum-head (Fig. 81, 5, 5). Generally in such cases the attic is little involved and the membrana flaccida imperforate. A perforation in the membrana tympani may vary from the size of a pin-hole to that which embraces the entire drum-head. Usually, even in the worst cases, a rim about the annulus tympanicus is left, from which, if the purulency is stopped, a new membrana may grow. The usual seat of a perforation is in the posterior half of the membrane. Multiple perforations are rare; sometimes, however, two may be found

close together in the under part of the membrane, separated by a thin band, and in very rare cases three perforations may be found in the same membrane. The handle of the malleus may remain intact, notwithstanding great destruction in the drum-head. In other instances the manubrium may be more or less eroded as the perforation extends. If the membrana is destroyed, or if the perforation in it is in the upper and hinder part, the lower portion of the long process of the incus, the incudo-stapedial joint, and the rami of the stapes, as well as the niche for the round window, may come into view after the ear is cleansed from pus and then dried out with cotton on a cotton-holder. Nevertheless, a large perforation may exist in the upper and hinder parts of the membrana tympani, and the incus and stapes be intact, yet invisible, because the mucous membrane about them is too swollen to permit of their ready recognition. When a large perforation is in the upper posterior quadrant, the lower ends of these ossicula may be seen by inclining the patient's head towards the opposite shoulder, and then looking up and behind the rim of membrana still intervening between them and the observer. This view will be favored by the observer's slowly moving his head and eye so as to command all parts in the region of the roof of the tympanum.

There is a form of chronic suppuration of the middle ear originating in and usually limited to the attic space (*recessus epitympanicus*), or upper part of the drum-cavity beneath the tegmen tympani (Fig. 22, 1). These are the so-called "attic cases." They are characterized by a perforation in the membrana flaccida or Shrapnell's membrane (Fig. 81, 1, 1), an imperforate membrana tensa, the part below the folds of the drum-head, and a scanty, offensive discharge, clinging chiefly to the upper wall of the auditory canal. So slight is this discharge in most cases of attic suppuration that the membrana tensa is generally entirely dry, and when the ear is first inspected it appears to be free from secretion. Upon close examination, however, of the upper wall of the auditory canal and the upper part of the membrana, above the line of the folds and short process, a film of pus will be seen. When this is mopped away the perforation in the membrana flaccida will

FIG. 81.



Outer surface of a normal membrana tympani, left side; magnified three and a half diameters. (Poltzer.) 1, 1, membrana flaccida (Shrapnell's membrane); 2, short process of the malleus; 3, posterior fold of the membrana tympani; 4, incus-stapes joint showing through the membrana; 5, 5, membrana tensa, behind which lies the atrium; 6, 6, 6, 6, inner end of the bony auditory canal, forming a frame for the membrana tympani; 7, pyramid of light; 8, umbo, containing the lower end of the handle of the malleus; 9, anterior fold of the membrana.

be made apparent. This perforation may be very small, and a small granulation or polyp may lie over it or protrude through it. If the perforation is large, the neck of the malleus may be seen through it, or if a portion of the margo tympanicus—the osseous edge of the squama forming the part of the tympanic ring at the Rivinian segment—has been destroyed by caries, the entire head of the malleus and part of the body of the incus connected with the malleus may be visible. Sometimes, though this perforation is very large, disease having destroyed the head of the malleus and the incus, the perforation reveals an empty antro-tympanic space.

Membrana Flaccida.—The membrana flaccida may be briefly described as a fan-shaped region, the lower borders of which, or the imagined sticks of the fan, run backward and forward from the short process of the malleus above the upper edge of each so-called fold of the membrana tympani, forming a lower boundary about five millimetres long (Fig. 81, 1, 1). The upper edge of this important part of the membrana tympani corresponds to that peculiar part of the general periphery of the drum-head known as the segment of Rivinus. The latter is more accurately described as the margo tympanicus (the scute) or inner edge of the upper bony wall of the external auditory canal, and forms the osseous complement at this point of the annulus tympanicus. The membrana flaccida thus outlined is about three millimetres high, measuring from the short process of the hammer up to the point of attachment of the membrane to the upper osseous wall of the auditory canal. This membrane is composed of only two layers, an outer cutaneous one from the auditory canal and an inner mucous layer from the tympanic cavity and inner surface of the margo tympanicus. Directly behind the central part of the membrana flaccida is the neck of the malleus, the head of which lies behind the margo tympanicus (Fig. 30, 2). The front part of this membrane is stretched over the anterior upper part of the tympanic cavity, entrance to which, at this point, is above the so-called anterior pocket of the drum-head. The back part of this flaccid membrane, behind the neck of the malleus, is stretched over the front end of a long and shallow groove yet to be described, and at this point the membrana flaccida is about two millimetres from the lower part of the body of the incus. This posterior groove-like cavity is wedge-shaped, bounded on its inner side by the upper part of the body of the incus and its short horizontal process, and on its outer side by the inner surface of the margo tympanicus. The edge of the wedge-shaped groove points downward and its base opens upward towards the tegmen, while in its long diameter it widens and forces a way backward into the tympanic cavity and the mastoid antrum. At its anterior end and on its outer side this groove is covered in from the external auditory canal by the back part of the membrana flaccida. Hence when this membrane gives way at this point, egress is afforded to matter from the upper and back part of the tympanic cavity and from the mastoid antrum (Fig. 22).

Various Positions of the Perforation.—Sometimes a perforation in the membrana flaccida is directly above the short process of the malleus, opening into what is termed by Prussak and Brunner a “third pouch of the membrana tympani.” In perforations of the *central part* of the membrana flaccida the neck of the malleus is exposed. In anterior perforations of this membrane, entrance is effected directly into the large upper space in the front part of the tympanic cavity, near the tympanic end of the Eustachian tube.

Posterior perforations are usually attended by great discharge and mastoid symptoms; they are also most obstinate and accompanied by profound deafness. Central perforations are most likely to be connected with disease in the external auditory canal, but are less obstinate to treatment and are not usually associated with profound deafness nor so great a discharge.

Anterior perforations are most likely to be connected with disease in the nares, the Eustachian tube, and the tympanic cavity, and they give exit generally to a more copious discharge than any other form of attic disease.

In cases of destruction of the entire membrana flaccida, attended by erosion of the margo tympanicus, there come into view, directly over the line of the folds of the drum-head, the neck and head of the malleus and the junction of the latter with the incus, the body of the incus with the upper part of its descending crus, and the proximal part of its short horizontal crus. In such cases of extensive destruction the entire dome of the tympanum under the roof can be viewed by turning the patient's head to the opposite side. There may also be seen the cavity of the upper and front part of the tympanum, and a dark cavity in the back part of the space thus opened around the head of the malleus and body of the incus, which is the entrance to the mastoid antrum.

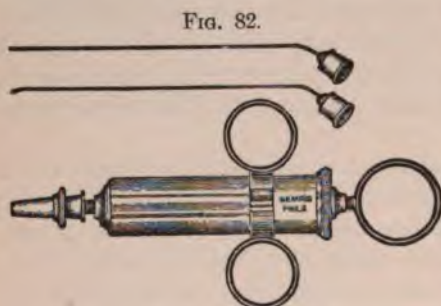
When the perforation is in the anterior part of the membrana flaccida, Valsalvian or other inflation is likely to produce a characteristic perforation-whistle; but when the perforation is elsewhere in the flaccid membrane, a perforation-whistle is not likely to be produced. This can readily be understood upon reflecting that, except in anterior perforations, the head and neck of the malleus and the body of the incus intervene between the cavity of the tympanum and the perforation. Another peculiarity of these cases in which a wide perforation is in the membrana flaccida is the absence of perforation in the membrana tensa below the folds. Even when disease in the atrium exists, with purulency in the attic, the perforation in the membrana flaccida is often the only outlet. Doubtless there are cases in which purulency in the antrum, with a perforation in the membrana tensa, is associated with purulency in the attic and a perforation in the flaccid membrane, but the more complete drainage of the drum-cavity offered by the lower perforation renders it very unlikely that the perforation in the flaccid membrane will be large or even continue to exist.

The deafness in cases of attic purulency is explained by the nearness of the suppuration to the ossicles of hearing and their impaired motility thus brought about. Patients with attic suppuration are more apt to suffer from dizziness than those with purulency in the atrium, because in the former instance the suppuration is more likely to irritate the stapes in the oval window, and thence the labyrinth through the tissues of the vestibule.

Perforation in the membrana flaccida always means necrosis in the malleus and perhaps in other of the ossicula auditus. It is fortunate if

this is not attended by necrosis in the margo tympanicus and other parts of the surrounding attic walls.

Treatment. — There are four methods of treating chronic purulent inflammation of the drum-cavity,—viz.: 1. By injection of fluids through the perforation in the membrana by means of a tympanic syringing or by inserting them on slender mops through the perforation, and squeezing out the



Tympanic syringe.

medicament by firm pressure. I prefer the latter. If a tympanic syringe is desired, one like that shown in Fig. 82 will be found useful; but no one but an expert can use it. 2. By the introduction of powders or solids through the perforation, if it is large enough. 3. By excision of the membrana tympani, including the remnants of the membrana flaccida, the malleus, and the incus. 4. If all of these methods fail to cure chronic purulency of the middle ear, the surgeon should resort to a surgical exposure of the middle-ear cavities, the drum-space, the aditus and antrum, and the removal of all diseased tissue in them. The methods of accomplishing this will be described later on.

Antisepsis can be best obtained by syringing the ear by the way of the auditory canal or by mopping it with absorbent cotton. Cleansing the ear, as about to be described, should be done only by the surgeon. For syringing the ear, a solution of common table-salt in warm water (five per cent.), a solution of carbolic acid (two and a half per cent.), a solution of bichloride of mercury (1 to 3000 or 1 to 4000), and a weak solution of potassium permanganate are among the simplest and best. If the secretion is very thick and tenacious, a solution of hydrogen dioxide may be instilled slowly into the ear. This valuable drug cannot be heated without decomposing it, and therefore has to be used at the temperature of the surrounding atmosphere. It thus constitutes an exception to the rule to use warm solutions for instillation or syringing into the ear. This solution breaks up thick pus, and then the ear may be further syringed and thoroughly cleansed with an antiseptic fluid.

It should not be necessary to say that the injected fluid must be kept separate from the return fluid which comes from the ear loaded with the products of suppuration. This can be done by using a vessel with a partition across the diameter, or by having two basins, one full of the fluid to be injected and the other empty for receiving the washings from the ear.

If the quantity of discharge is both slight and thin, it can be mopped out of the external auditory canal and its fundus by absorbent cotton on a cotton-holder, under thorough illumination of the ear by the forehead-mirror (Fig. 57) or the forehead electric lamp (Fig. 55).

While this method will grossly cleanse the ear, so that a view of the fundus of the canal and the membrana tympani may be obtained, it will not chemically cleanse it and render it aseptic. Therefore, if a more thorough antiseptics is to be sought by means of the mop on the holder, the cotton mop must be soaked with some antiseptic, and the fundus of the canal and the tympanic cavity, as far as possible, gently but thoroughly mopped and washed with the excess of the antiseptic fluid which will be then squeezed out into the diseased region, under good illumination, as just stated. There must be no perfunctory mopping in the ear in any case, nor any guesswork about these manipulations. Therefore they can be done only by the skilful and conscientious surgeon.

After the ear is cleansed it should be thoroughly and most carefully examined first for granulations and polypi. If such complications are detected, they must receive treatment as hereinafter described.

If these obstructions to treatment and vision do not exist, a slender but blunt probe should be passed carefully down the canal, and the walls of the osseous canal, the malleus or its remnant, and the inner wall of the tympanic cavity should be cautiously examined for denuded, carious, or necrotic spots. It is very important to know whether the latter conditions exist in the ear about to be treated, as their presence contraindicates all forms of caustic treatment, especially in caries of the inner tympanic wall. The facial canal, which at best is separated from the tympanic cavity only by a thin osseous wall, and which often, even in a healthy ear, has a dehiscence in it from defective ossification, is easily penetrated by any fluid put into the drum-cavity, and the facial nerve directly attacked. If caries of the inner wall of the drum-cavity exists, the thin facial canal-wall is almost surely open and the facial nerve exposed. It is not uncommon to see an acute attack of otitis media from a cold in the chronically diseased ear followed by facial palsy, simply from pressure upon the nerve by the swollen mucous membrane of the drum-cavity. What may not follow the application of a caustic to the carious tympanic wall if the facial canal is open? In fact, lasting facial paralysis has thus been caused. The treatment of caries of the canal, the malleus, and other ossicula of the tympanic cavity and adjacent parts will be considered farther on. Whether or not caries and necrosis exist, in chronic

tumors, distinctly illustrating the doctrine of the inflammatory origin of all neoplasms.

Aural polypi should be classified as follows : 1. *Granulation-tumors*. 2. *Soft papillomata*. 3. *Fibromata*. 4. *Myxomata*.

It cannot be said that there is any special train of symptoms indicative of the presence of an ordinary aural polypus. Wherever a chronic purulent discharge from the ear has existed for some time, the presence of a polypus may be suspected, especially if from time to time there has been any hemorrhage from the ear. Usually, however, the only symptom is the chronic discharge from the ear.

Reflex Phenomena.—In some rare instances aural polypi may produce hemiplegia, anæsthesia, and ptosis without facial paralysis on the corresponding side. Removal of the polypi usually causes the symptoms to vanish. Other reflex phenomena from the peripheral irritation arising from a polypus in the ear have been observed, such as epileptiform convulsions, severe occipital pain and pain in the ear, unsteadiness of gait, elevation of temperature, complete paralysis of the facial nerve,¹ a constant tendency to faintness, and great muscular weakness, all of which have disappeared upon the removal of the polypus from the ear.

Hemicrania, sensations of fulness in the ear, vertigo, retention of pus, nausea, and vomiting have often been observed as a result of the presence of a large obstructive polypus in the auditory canal; but they are not to be regarded as characteristic of the presence of polypi generally. The vast majority of aural polypi are first discovered by the surgeon when the patient applies for relief from a chronic aural discharge, the latter being the only symptom.

Treatment of Granulations and Polypi.—Granulations usually disappear under careful antiseptics of the ear, especially when it is maintained by powders or by instillation of alcohol. If this simple form of treatment does not check the discharge and cause the granulations to disappear, the latter may be most carefully touched with chromic acid. This should be done by dipping a probe, with an end not more than one millimetre in diameter, into a drop of deliquesced chromic acid crystals, and then touching, under perfect illumination, each granulation with the point of the probe thus wet with the escharotic. Nothing but the granulation should be touched by this powerful acid. The part touched instantly turns yellowish white, and the discharge from the ear is usually a little increased for a day or two, owing to the sloughing induced by the caustic. This acid should never be applied to the ear except under the most perfect illumination from the forehead-mirror or the forehead electric lamp, and by a skilled hand. Any other course will surely produce a slough in healthy tissue and the ear will be made worse. Fortunately, the antiseptic powder already named will usually cause granulations

¹ R. W. Seiss, University Medical Magazine, Philadelphia, July, 1889.

to disappear without resort to chromic acid. Let it be distinctly understood that the latter should never be applied to the ear on cotton on the cotton-holder or in any other way, as too much acid will be taken up by the cotton, and, when pressed upon the granulation, more than is required will be pressed out and will run over adjacent tissues.

Polypoid hypertrophy of the mucous membrane of the middle ear, with hernial protrusion through the perforation, is often mistaken for a polypus and treated as such by caustics. Unlike a polypus, such protrusions of mucous membrane are very sensitive to the touch, while true pedicellate polypi are not. This will serve in establishing a differential diagnosis and greatly modifying the treatment. A protrusion of the mucous membrane should never be cauterized nor snared off, as it will disappear under insufflations of antiseptic powders. This I have verified repeatedly. Cantherizing or snaring them is not only painful, but is very likely to set up an acute otitis media.

A true *pedicellate polypus* in the ear is not difficult of diagnosis. After the ear has been cleansed, inspection of the auditory canal and fundus reveals a more or less bright red and shining body either in the fundus, near or upon the membrana tympani, or farther outward in the canal, nearer the meatus, the lumen of which is often filled by the growth by the time it has extended so far outward. A more or less copious and offensive discharge from the ear exists at the same time, and usually it is for the latter that the surgeon's aid is asked.

The first step in the case must be the removal of the polypus, in order to free the ear from the irritation of its presence, to perfect drainage of pus from the middle ear, and to apply medication. Patients must be told that the removal of the polypus is only the first step in treatment, as its pedicle or "root" must be thoroughly destroyed in order to prevent regrowth. If the pedicle is properly treated, regrowth never occurs, though an entirely new polypus might form if the discharge were not checked, or if the ear were entirely neglected as to daily cleansing.

A little cocaine (a five or ten per cent. solution) may be dropped into the ear in order to blunt the sensibility of the walls of the auditory canal and fundus; the polyp itself is insensitive. However, this is not demanded if the operator has skill and his instrument is slender. Furthermore, cocaine does not act readily on the skin-tissue of the external ear. Patients, however, are often reassured by dropping a solution of cocaine in the ear before a polypus is to be extracted.

Polypus Snare.—The only good surgical means of removing an aural polypus is the so-called polypus snare. This should consist of a slender canula, six centimetres long and one millimetre in diameter, as modified by the author from the Wilde and Blake instruments. The former is entirely rejected at the present day on account of its clumsiness and size. In its original condition it was too large to be convenient, because the width of the shaft and the exposed wires was nearly as great as the canal

diameter itself, and hence darkened the canal and filled it up so that the distal end of the instrument could not be seen, in most cases, after it had passed beyond the meatus.

C. J. Blake confined these wires forming the snare in a canula that flared slightly at the end, and thus at once provided the aurist with a compact polypus snare. Subsequently, C. H. Burnett narrowed the canula still further and did away with the flare at the loop end, which gave a better view of the fundus and the body about to be seized by the snare (Fig. 83). Across the mouth of the canula is placed a little bar, which prevents the loop from being drawn into the barrel. Various kinds of wires and threads have been employed to run in the canula and form the loop. In the writer's experience no form of wire acts so well in this instrument as the brass wire used in harness-making. It is bright, fine, and flexible without being too flimsy to maintain a loop, and is quite strong enough to constrict an aural polypus pedicle. Iron and silver wire are too stiff, and hence make loops at once unmanageable and harsh.

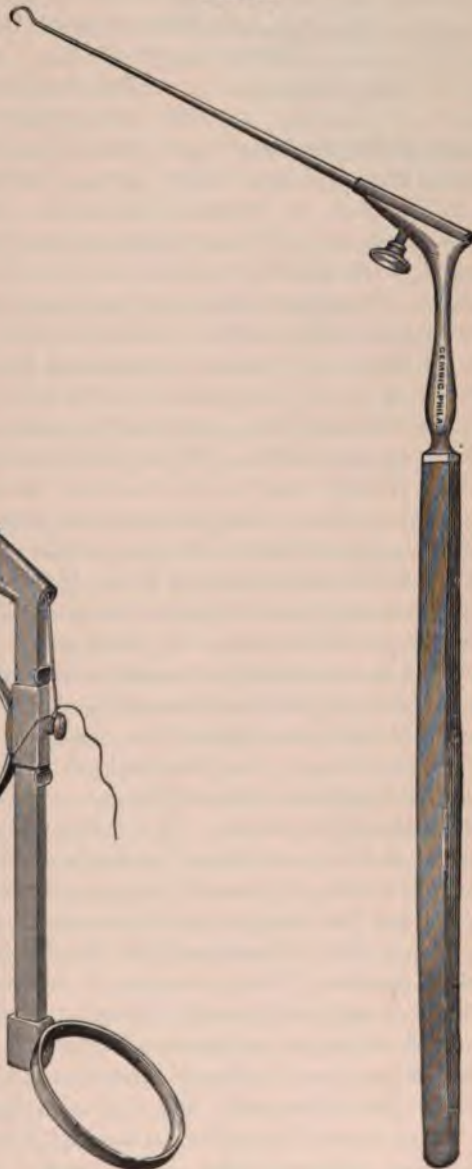
Polypus Hook.—Sometimes small polypi may be caught and removed on a hook made for that purpose. But hooks are treacherous objects in the ear, as in so narrow a place they are likely to catch hold of the walls of the canal and inflict painful wounds, which are avoided by using the slender forms of polypus snares. Therefore, if a hook is employed for the removal of a polypus, it must be very slender and small (Fig. 84) and used only by the skilled hand under the best illumination of the ear. Polypus cannot be removed from the ear by means of the slenderest forceps. The separation of the blades in the narrow canal is always painful, even if the instrument is most slender and delicate, and if the instrument is of the latter description it could not maintain a hold upon the slippery polyp, even if it by chance obtained it.

The polyp having been examined with a probe to determine where its pedicle is attached, a loop a little larger than the polypus should be formed at the end of the canula. Generally a polypus in the fundus of the canal will lie over the membrana tympani. In such a case the loop may be turned nearly at right angles to the canula, so that it can be placed over the polyp without the canula's interfering with a view of the operation. Now a gentle traction on the trigger will draw the loop into the canula and constrict the pedicle. The polypus is almost always retained in the tightened loop and is removed with the instrument. If it is not, it can be syringed from the ear or drawn from it with slender forceps or a cotton-holder.

If there is another polyp in the ear it will be revealed after the removal of the first, and is to be treated in the same way. As it lies deeper, it will require more care and skill to snare the inner one. More or less hemorrhage follows the removal of aural polypi. This is very slight—a few drops—in the removal of small ones. When they are as

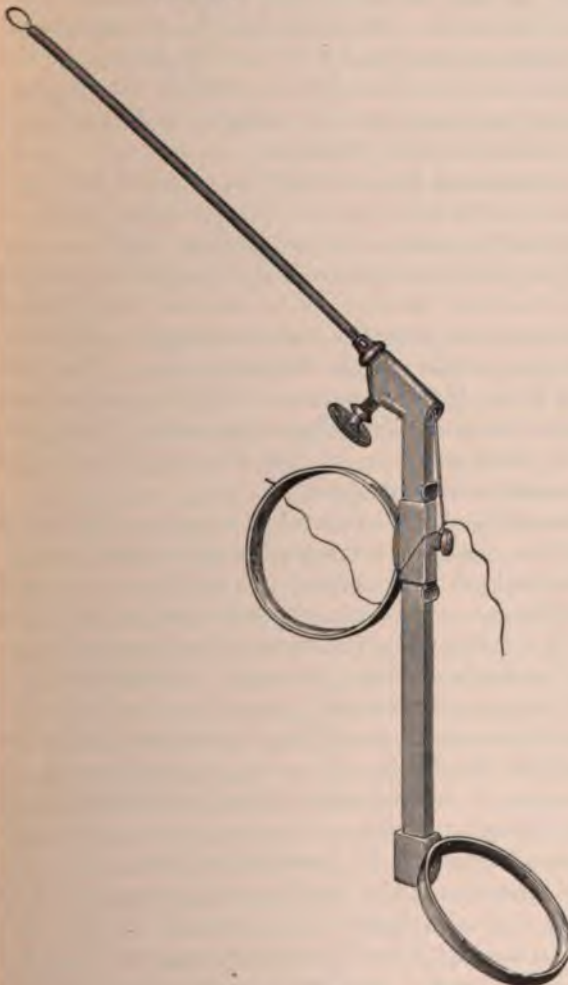
large as a large pea, or still larger, sometimes from a fluidrachm to a fluidounce of blood may be lost. In any case this can be quelled by hot-

FIG. 84.



Polypus hook.

FIG. 83.



Polypus snare.

water injections into the ear. After the bleeding has ceased and the ear been cleaned, search should be made for the former attachment of the

polypus. When this is found, if it is large, it should be bitten off with tweezer-like forceps, or "jaws" made to work in the foreign-body forceps of the Sexton pattern (Fig. 85). If it is too small to seize in any way, it should be touched with chromic acid in the manner already described (page 184).

FIG. 85.



Tweezer forceps.

After the point of attachment of the polyp has been carefully touched with *chromic acid*, some antiseptic powder, preferably that composed of boric acid and calendula (page 182), should be blown into the fundus of the canal, and the ear let alone for twenty-four hours. The next day the ear should be examined, and, if the powder is found to be dry in the fundus of the canal, it should be let alone until the next day, or until discharge reappears. Sometimes this does not reappear, the removal of the polypus being followed by entire cessation of the otorrhœa.

If, however, discharge reappears, the ear must be mopped and rendered as aseptic as possible. Then the seat of the operation must be dried with absorbent cotton and examined to see whether there are any traces of the pedicle. If the polyp has been a large one, the cut surface of its pedicle may require another touching with chromic acid in the course of two or three days, or whenever the whitish slough is detached and the red surface of the cut pedicle can be distinctly seen. Then the same antiseptic powder is to be blown into the ear and the same course of treatment pursued until all trace of the polypus has gone. If the discharge continues after the disappearance of the polypus, it is to be treated as an ordinary uncomplicated otorrhœa.

Excision of the Membrana and Ossicula.—It must be borne in mind that a perforation in any part of the membrana tympani is only a symptom of a deeper disease. On the whole, it is beneficent: it facilitates drainage and medication of the middle ear, and is nature's indication of the path of treatment to pursue. This is the further removal of the diseased membrana and the two larger ossicula or their remnants, if antiseptic and aseptic treatment alone fail to cure the disease in the drum-cavity.

When the membrana is in a normal condition it holds the malleus in a proper state of isolation from the incus and favors the transmission of sound-waves. When, however, it is perforated it becomes retracted, as stated above, and permits retraction of the malleus and incus and impaction of the stapes in the round window. Its inner surface being inflamed, as it always is in chronic purulency, and studded with granulations, it blocks the drum-cavity and favors further septic retention. If the perforation is small, medication through it is difficult and imperfect, and the surgical removal of the membrana and malleus is as much indicated as that of a polypus or diseased tissue and necrotic bone anywhere else. In all cases of chronic purulency of the drum-cavity the malleus and incus will be found more or less invaded by caries. The stapes resists this pro-

cess a long time. Therefore, if antiseptics fail to check chronic purulency in the drum-cavity, it is irrational and contrary to the teachings of modern surgery not to excise the necrotic elements, thus favoring drainage and also a more perfect medication of the diseased mucous membrane in the drum-cavity. If the stapes has not been invaded by necrosis so as to destroy its foot-plate, the hearing will be improved to a greater or less degree by this operation, even if the rami of the stapes are gone. With the drum-cavity thus cleared, medication, if it has not been too long deferred, will prevent extension of purulency and necrosis to the antrum, the mastoid region, and the vital parts beyond. Like other successful treatment, it is prophylactic of more serious evils.

Ossiculectomy.—In performing ossiculectomy in chronic purulent otitis media the patient should be etherized in order to prevent his suffering and to keep him perfectly still; movement of the head defeats the operation. Ossiculectomy has been performed under local applications of cocaine, but the anæsthesia is not total and the patient flinches or moves more or less. Again, as a good deal of cocaine solution is required, there is some risk of toxic effects. The patient being under ether, the ear must be illuminated by an electric lamp held on the surgeon's head (Fig. 55).

The remnants of the membrana, over the region of the incus-stapes joint, should first be cut away (if not already eroded by disease and the malleus in part or in whole is still present) and the incus looked for. Sometimes the entire incus will be found in position, with its long process in connection with the stapes-head and its body still in articulation with the head of the malleus. But this is the exception in chronic purulent otitis media. Most frequently the incus is entirely destroyed by caries. Sometimes the body of the incus, without its long limb, is found fused with the malleus-head, and is removed with the latter, when the malleus is seized with forceps and removed from the drum-cavity after severance of its suspensory ligaments, synechiæ, etc. In other instances the body of the incus is partly destroyed by necrosis, its posterior part being intact and the long limb still attached to the stapes. If the incus is present with the malleus, the former should be removed before the malleus is disturbed. If the malleus is removed first, the incus, unless adherent to it, may fall into the lower posterior part of the drum-cavity and be lost, or recovered only after considerable, and probably irritative, grappling. The incus being found and removed, the malleus may then be excised. Sometimes the remnant of the incus is not found until after the malleus is removed. Then with an incus hook-knife (Fig. 77, 4) passed into the attic the incus is thrown forward and downward into the atrium and removed. In no case of chronic purulent otitis media should the stapes be removed, or even mobilized, for fear of opening the oval window and inviting the entrance of pus into the internal ear and thence into the cranial cavity.

The initial incision in the membrana may be made with a sharp-pointed knife (Fig. 77, 2), but further cutting should be made with a blunt-pointed one (Fig. 77, 1). The incus is best detached from the stapes by means of the incus hook-knife (Fig. 77, 4), and if adherent to the attic should be turned forward into the front and lower part of the drum-cavity by means of an incus hook-knife with a longer and blunter blade than that for detachment of the incus from the stapes. When the incus is entirely freed from its attachments it may be drawn from the drum-cavity by the blunt incus hook-knife or by means of the foreign-body forceps of Sexton's pattern (Fig. 85).

In no case should the drum-cavity be curetted, as such a procedure is very likely to wound the facial nerve and induce facial palsy. It is, furthermore, unnecessary, as, under proper antisepsis, granulations will disappear and denuded bone surfaces be covered in with new membrane.

After removal of the diseased remnants of the membrana and ossicles the ear should be mopped with an antiseptic like alcohol or a solution of bichloride (1 to 5000) or formalin (1 to 1000), the meatus stopped with a light tampon of sterilized gauze, and the ear let alone for twenty-four hours. If the gauze in the ear becomes moist with blood or bloody serum, it should be removed and a dry dressing put in the meatus not far in the canal. In all cases the discharge diminishes at once, and ceases entirely in the majority of cases within a period ranging from one to eighteen months. The after-treatment should consist in mopping the discharge from the ear and the instillation of a formalin solution (1 to 1000) from once a day to once a week, according to the quantity and frequency of the discharge. The hearing improves to varying extents, the general health of the patient is rendered better, and he is freed from the danger of extension of the suppuration to the mastoid and cranial cavities.

If all of the foregoing methods fail to cure uncomplicated chronic purulent otitis media,—chronic otorrhœa,—the surgeon should resort to the so-called radical operation on the middle-ear cavities,—*i.e.*, upon the tympanic cavity, aditus, and antrum. This consists in detaching the auricle from the upper posterior bony wall of the external auditory canal, drawing the auricle or auricular flap forward, and then, if the bone be intact, removing with the chisel or gouge the scute, the outer wall of the aditus, and that of the antrum. This operation makes one cavity of the external auditory canal, drum-cavity, aditus, and antrum. After all diseased tissue is thus removed, the new-formed cavity must be epidermized or cornified before a cure can be said to be secured. In the after-treatment of the retro-auricular wound I cannot advocate the maintenance of a retro-auricular opening until the new-formed cavity is dermized by treatment applied through this opening. After this is done, the retro-auricular wound may be closed by a plastic operation; or it may be left permanently open, as some surgeons prefer, in order that the new-formed cavity may be inspected as desired. Others prefer, after *all diseased tissue*

is thoroughly removed from the middle-ear cavities, to let the wound fill with a blood-clot, and then bring the edges together, firmly suture, and seek for union by first intention. The subsequent treatment for cornification rather than dermizing the new-formed middle-ear cavity is to be conducted through the external auditory meatus. As the drum-cavity, aditus, and antrum are mucous-lined, the processes of nature in healed cases indicate the advisability of trying to cornify the mucous lining, after resection of carious bone from these regions, rather than endeavoring to line it with true skin. Skin in such a cavity is heterotopic, and observation shows that nature does not adopt this method of healing a suppurating ear.

Exuberant granulations in the new-formed cavity are to be kept down by the judicious use of chromic acid. When the granulating surface becomes smooth and paler, the process of cornification, or epidermizing of the walls of the new cavity, may be advanced by the insufflation of a powder of ichthyolized boric acid (ten per cent.), or one of silver nitrate and boric acid thoroughly pulverized (twenty grains to the ounce).

CHRONIC PURULENT OTITIS MEDIA, WITHOUT EXTERNAL SYMPTOMS, IN YOUNG CHILDREN.

Grave Diseases in Young Children are often due to Latent and Unsuspected Chronic Inflammation of the Middle Ear.—The importance of this subject to the physician and the danger to the child lie in the latent and unsuspected existence of subacute or chronic purulent otitis media. When there are objective or subjective symptoms of ear disease in a young child, the attention of the medical attendant is called to the existence of an ear disease in the case, even if the ear is not treated; but if there are no such symptoms in an ill child, naturally even a grave disease of the middle ear would easily escape detection. That just such oversight occurs in young children, with fatal results, has been pointed out most forcibly by Ponfick,¹ Simmonds,² and E. H. Pomeroy.³

It has long been known that of all middle ears examined in infants, dead from any asserted cause, normal ones are a rarity, a large proportion being found to be the seat of suppuration, unsuspected and unrevealed until the autopsy, as may be learned from the writings of von Troeltsch, Schwartze, Wreden, and others; but that the latent ear disease had caused the fatal general malady in most instances was not suspected until Ponfick, of Breslau, in 1897, had his suspicions aroused that in his own children there existed a causal relation between suppuration of the middle ear and severe gastro-enteritis. He suspected that the ear disease was the cause, not the effect, of the general malady. Upon curing the

¹ Berliner Klin. Wochenschr., September and October, 1897.

² Archives of Otology, October, 1898.

³ Boston Med. and Surg. Jour., January 18, 1900.

suppuration of the middle ear, his children rapidly recovered from gastro-enteritis without other treatment.

Being professor of pathology in Breslau, Ponfick at once began, in one hundred consecutive cases, an examination of the middle ears of dead infants under three years of age. In this series death was attributed to various causes. In the entire series of one hundred cases, in less than nine per cent. had there been a spontaneous rupture of the membrana tympani or any other so-called external symptom of ear disease. None of them had been supposed to die of disease connected in any way with aural inflammation, unless, perhaps, the six cases tabulated as otitis media be excepted. Yet in one hundred individuals there were one hundred and sixty-eight diseased tympana,—viz., seventy-seven ambilateral (one hundred and fifty-four tympana) and fourteen unilateral. In Ponfick's opinion, these children had in most instances died of disease originating in what may be termed in a general way a symptomless chronic aural suppuration,—that is, there had been no pain in the ear, no discharge, nor any external ear symptoms.

The figures of Simmonds¹ are still more alarming. In one hundred and thirty-three autopsies in nursing infants the middle ear was free from exudations in only five cases. He holds that more or less serious lesions of the kidneys are found in all forms of pedatrophs in nursing children, and that these are in most instances due to otitis media. Systemic infection is more easily brought about from the young child's ear than from the adult's, because the middle and internal ears are just as large in the new-born child as in the adult, though not at first surrounded by dense osseous tissue, as in the adult bone.

An osseous external auditory canal does not exist in a new-born child (Fig. 9). Its little auricle is practically attached by a fibro-cutaneous canal to its annulus tympanicus, from which, with the squama, is formed the osseous external auditory canal, about half its natural length being attained at twelve months and its full length at six years. At birth, however, the membrana tympani of the young child is just as large as the adult's, but much thicker, and continues so for many months. This fact may explain the infrequency of spontaneous rupture of the membrana tympani in otitis media in early childhood. Therefore, in the middle ear, for reasons just given, there is an almost vital organ in the young child. That serious inflammation of the middle ear in an infant exists without much, if any, pain may, perhaps, be accounted for by the fact that enough pus may escape from the drum-cavity into the nasopharynx through the short, wide Eustachian tube of a young subject to relieve tympanic pressure and prevent pain in the ear. This escape of pus into the nasopharynx further explains the infrequency of spontaneous perforation of the membrana in young subjects affected with otitis media.

¹ Loc. cit.

It has become very clear to many minds that the reason so many young children die is because the real origin of their fatal malady—a middle-ear inflammation—is unrecognized and therefore untreated. If an eye is bloodshot, any one can see it; but if a membrana tympani is congested and bulging with pus behind it, it requires an expert to detect it.

Treatment.—It has been shown by Ponfick and others that a latent and unsuspected, and hence untreated, otitis media is very often finally the cause of a fatal disease in young children, attributed, however, to something else. Such an unsuspected otitis media is practically symptomless until the membrana tympani is inspected, when the latter will be found presenting evidences of inflammation in the drum-cavity beyond,—viz., redness and bulging.

According to some observers, there is otitis media in *all* grave diseases in young children, and, this being the case, it becomes the duty of every practitioner in attendance upon an ill infant or young child to make an examination of the membrana tympani as much a part of his routine examination as inspection of the tongue. The physician must not wait for “external symptoms,” like otorrhœa, etc. If the ear is examined, the membrana tympani in many cases will be found to show signs of accumulation of secretion behind it in the tympanic cavity. If, now, the membrana tympani is incised and the pent-up secretions allowed to escape, symptoms attributed to brain, bowel, or lung diseases will suddenly vanish and the child speedily recover. So important are these facts that it is evident that the physician who cannot examine the infant’s membrana tympani, diagnose a tympanic suppuration, and relieve it by paracentesis is unfit to act as a specialist in children’s diseases.

Barth¹ says that “we can conceive of the reasonableness of a daily examination of the ears of all unwell infants, from the beginning of their illness to the end of convalescence.” This, in my opinion, is asking of the general practitioner an impossibility, because, as a rule, he receives no instruction in such matters in his medical school. If instruction in otology is given the medical student without requiring any knowledge of this subject in his examinations for a degree, he will never learn anything about otology. The medical student never has learned anything not required at the final examination, and never will. He cannot be blamed for this, because he naturally regards as unimportant that upon which his teachers do not examine him for his degree.

Intelligent inspection of the membrana tympani is not an easy thing to learn. I heard Gruber, of Vienna, say, in 1871, that he would not accept the statement of a physician regarding the condition of the membrana tympani until such a one had examined a great many membranæ every day for a year. It is only by such experience that an examiner of the membrana can interpret what he sees upon this important organ.

¹ Archives of Otology, October and December, 1899.

CHAPTER XVIII.

SEQUELÆ OF CHRONIC PURULENT OTITIS MEDIA.

AMONG the earliest prominent and grave sequelæ of chronic purulent inflammation of the middle ear may be named facial paralysis, cholesteatoma, and chronic mastoiditis. Later there may occur deeper intracranial lesions, which will be considered in subsequent chapters.

PARALYSIS OF THE FACIAL NERVE IN EAR DISEASES.

Very often there are anatomical peculiarities in the middle ear favoring facial paralysis. Into the etiology enter (1) exposure to cold; (2) local diseases of the entire organ of hearing, such as diseases of the auricle and auditory canal, diseases of the middle ear, like serous and mucous catarrhs, acute purulent otitis media, and especially chronic purulent otitis media; (3) traumatism; (4) new growths in the organ of hearing; (5) tumors at the base of the skull; and (6) paralyzes resulting from intracranial lesions of otitis.

Concerning the anatomical and histological changes in the facial nerve occurring in paralysis thereof very little is known. The changes that have been demonstrated are hyperæmia and swelling of the neurilemma from infiltration and growth of connective tissue, purulent infiltration of the neurilemma and of the facial nerve in purulent inflammation of the middle ear and caries of the walls of the drum-cavity, atrophy of the facial nerve, absorption thereof in consequence of induration and compression or through pressure from hyperostosis of the facial canal, degeneration from induration of the nerve, and total destruction of the nerve.

Symptoms.—Paralytic symptoms in the tract of the facial nerve are more marked in peripheral than in central affections of the nerve. As prodromes of facial paralysis may be named pain in and behind the ear and corresponding side of the face, in the line of the auricularis magnus nerve and second branch of the trigeminus. Sometimes there are tinnitus aurium and abnormal sensations of taste. The paralysis may affect all or only some of the branches of the facial nerve. A frequent symptom is paralysis of the soft palate on the affected side. This symptom has never been explained, as the experiments of Rethi (1893) show that the soft palate is innervated by the vagus. Facial paralysis in aural diseases begins either by degrees or with marked variations. In some cases total facial paralysis comes suddenly, either with or without prodromes. Lessening of the paralysis is indicated by improvement in certain branches first, followed later by others. Recovery may never occur

PLATE IV.



Facial paralysis caused by acute purulent otitis media tuberculosa. Muscles at rest.



The same case. Muscles in action on the unaffected side.

PLATE V.



Facial paralysis occurring in the course of chronic purulent otitis media. Muscles at rest.



The same case. Muscles in action on the unaffected side.

in some branches, as, for example, in that of the nasolabial fold or of the levator palpebrarum. In children, facial paralysis may lead to arrest of development of the face and sometimes to atrophy of its muscles.

Diagnosis.—The diagnosis of facial paralysis is not difficult, on account of the distortion induced. Differential diagnosis between central and peripheral paralysis is not easy to make in the early stages and in the absence of any objective lesion in the organ of hearing.

Prognosis.—The prognosis is more favorable in children than in adults, and in acute than in chronic inflammation of the middle ear. In acute cases the prognosis will be influenced by the general condition of the patient, being unfavorable in the otitis of the tuberculous, syphilitic, and cachectic. A favorable prognostic sign is the return and continuance of the normal reaction of the nerve under the application of the constant electric current. Discouraging symptoms are extinction of the galvanic reaction and atrophy of the muscles of the face. Loss of the perspiratory function of the paralyzed side of the face indicates atrophy of the nerve (Tomka). Facial paralysis with necrosis of the labyrinth, together with exfoliation of the cochlea and portions of the semicircular canals, is often evanescent. When accompanied by exfoliation of the internal porus acusticus with necrosis of the entire labyrinth, it is, with few exceptions, permanent.

Treatment.—The treatment of facial paralysis must be in accordance with the cause, the duration, and the seat of the lesion. *The application of electricity in acute cases is not indicated until pain, spasm, and all symptoms of reaction have disappeared, because by too early an application of the galvanic current the condition of the nerve may be made worse. When electricity is applied it should be in the form of a weak constant current through the mastoid fossa of the auricle, every other day, from two to three minutes.* Facial paralysis occurring in chronic purulent otitis media calls for both medical and surgical treatment of the underlying causative disease in the middle ear. Electricity does less good in chronic than in acute otitis.

Facial Paralysis occurring in a Case of Acute Otitis Media Tuberculosa.—On April 10, 1900, Benjamin F., forty-seven years old, an employee in an ice factory, stated that about March 23 previous he was attacked by a heavy cold; that in a week he experienced pain and deafness in the right ear, the membrana tympani of which soon spontaneously ruptured and the ear discharged pus, the pain ceasing. At the end of the second week of his ear disease he observed that the right side of his face was twisted towards the left, and he then presented himself at the Presbyterian Hospital for treatment (Plate IV.).

When first seen by me he was in the fifth day of his facial paralysis, which was total, even the tip of his nose being drawn towards the left. He complained of headache and malaise. Upon inspection of his ear, it was seen that a slight purulent discharge was running from the meatus and that the entire membrana, including the malleus, was destroyed.

The chorda tympani nerve was observed running in its normal course across the upper part of the plane of the annulus tympanicus, on its way to the Glaserian fissure. In the region of the aditus there was a bunch of red granulations very sensitive to the touch, in which was embedded a movable piece of bone, resembling a part of an ossicle, and which proved to be the long limb of the incus, to which was still attached the processus lenticularis. The entire inner surface of the drum-cavity as far as could be seen and felt was snow-white and denuded of muco-periosteum. Manipulation of the chorda tympani in its pink sheath of mucous membrane caused a pricking sensation in the man's tongue. The sense of taste was better on the left side. The facial palsy was so great as to render the patient's speech indistinct, from the clinging of the cheek to the jaws. The man had received no treatment before he came to the hospital. After his admission to the hospital his ear was kept clean by syringing once or twice daily with warm bichloride water 1 to 10,000, and later with a solution of 1 to 5000. The discharge from the ear became less, but very offensive in odor, suggesting that of necrotic bone. In fact, about a month after his admission, a dark rough sequestrum, filling the region of the aditus and attic, made its appearance. This was movable with a probe, and when thus manipulated a little blood oozed from about its sides and the patient was made to feel very uncomfortable. This proved to be the rest of the incus.

From May 16 to 31 the man failed rapidly; emaciation, evening rises in temperature, night-sweats, and cough set in, with development of a painful tubercular ulcer in the region of the left half-arch and posterior pharyngeal wall. From this period up to June 23 he had numerous slight hemorrhages (half a fluidounce) from his right ear. These apparently came from the region of the jugular bulb and floor of the tympanum. On June 23 tubercle bacilli were found in his sputa, and he was removed from the surgical to the medical ward. Here both apices and the middle lobe of the right lung were found to be consolidated. Owing to extreme weakness, the patient was now obliged to remain in bed; his aural and facial condition remained unaltered.

About once a week during July there occurred a hemorrhage of about half a fluidounce from his right ear. On the evening of August 9 he had a hemorrhage of at least a pint from his ear, after which the patient sank rapidly, dying on the 10th of August from tubercular exhaustion. It was not possible to obtain a post-mortem. Judging from their color and recurrence, it is probable that the hemorrhages came from the jugular bulb. Carotid hemorrhage would have been redder, solitary, and immediately fatal.

Facial Paralysis in Chronic Purulent Otitis Media.—In Plate V. is shown a case of facial paralysis occurring in chronic purulent otitis media as a result of violent treatment by inexperienced hands, and resembling somewhat a traumatic palsy of the facial. Soon after the violent syringings and

probing was discontinued, and the mucous membrane of the drum-cavity near the facial canal gently mopped with formalin solution (1 to 1000) once daily, the pain in the ear and the vertigo ceased, and the facial palsy of the face vanished in the course of a month.

Chronic suppuration of the middle ear advances by the successive stages of ulceration of the muco-periosteal membrane, periostitis, otitis, caries, and necrosis of subjacent bone. The interval between the acute stage and these successive chronic stages varies greatly in length. In some instances the acute stage is rapidly succeeded by all the others, even the necrotic exfoliation of some of the parts of the internal ear, while in others many years elapse before the chronic suppurative process in the muco-periosteal lining of the drum-cavity seems suddenly to induce caries and necrosis of the bone beneath, meningitis, encephalitis, sinus-thrombosis, pyæmia, and death.

Cholesteatoma.—Cholesteatoma of the middle ear and deeper parts of the petrous bone may be primary,¹ but it is most commonly the result of long-continued suppuration in the middle ear. It consists in a collection of quite densely packed laminated epithelial cells, undergoing fatty degeneration and intermingled with numerous cells of cholesterol. In some instances these cells are contained in a kind of capsule of connective tissue.² This accumulation of cells, resembling those of the epidermis, interferes quickly with the escape of the newer cells forming beneath its inner strata, and thereby increases the impaction and pressure of the mass upon the mucous membrane and the underlying bone. This leads to ulceration of the muco-periosteal membrane, the formation of granulations, absorption or erosion of the bone, and the invasion of deeper parts of the cranium.

Treatment.—In many instances cholesteatomatous masses may be syringed from the ear by means of warm water. If they are too dense to be removed in this manner, they must be softened by instillations of hydrogen dioxide or of a mixture containing sodium bicarbonate, gr. xx; glycerin, fʒii; and water, fʒvi. These should be instilled a little while before syringing and allowed to lie in the ear. Then the syringing, with gentle and patient picking with a probe, will dislodge the mass, or that part of it which is in the external canal and drum-cavity. Impactions in the mastoid cells can be reached and removed only by a mastoid perforation.

Stacke's Operation.—If caries of the attic wall exists and cholesteatomatous masses are found in it, the antrum and the mastoid may be found to be simultaneously affected with caries and cholesteatomatous collections. So convinced is Stacke that attic disease is accompanied by mas-

¹ Lucae, quoted by Schwartze, *Pathological Anatomy of the Ear* (Green's translation), p. 23.

² Toynbee, *Diseases of the Ear*, London, 1868.

toid disease, that he does not first excise the membrana and ossicula and wait to see the result before opening the attic and the antrum. He maintains that in the treatment of suppuration of the attic space the latter should be laid freely open so as to be thoroughly inspected after the removal of the malleus and incus. The method of doing this, as given by Stacke,¹ has also the advantage of enabling the surgeon to determine at once whether there is at the same time any disease in the mastoid. The method is as follows. An incision is first made through the soft parts down to the bone, beginning above the auricle just behind the temporal artery and running about a quarter of an inch behind the insertion of the auricle down to the point of the mastoid process. After the hemorrhage is quelled by ligatures, the skin and periosteum must be dissected or pushed up and away from the incision towards the auditory canal until the bony meatus is exposed. Then the cutaneo-periosteal lining of the osseous auditory canal must be detached from the posterior wall as far as the membrana tympani, until the latter can be distinctly seen. The entire auricular flap containing the posterior wall of the auditory canal should be drawn well forward, and the now exposed fundus of the canal and the diseased membrana illuminated by the electric lamp on the surgeon's head (Fig. 55). The membrana tympani and the malleus are then easily excised, and the attic laid bare by chiselling away the tympanic process of the squama forming its outer wall. Then the incus is to be removed if it is present, and the upper back portion of the annulus tympanicus and adjacent wall of the auditory canal should be cut away so as to expose the aditus and antrum. When the attic, aditus, and antrum are thus laid open, permitting a clear view of their interior, especially of the tegmen tympani and tegmen antri, carious spots should be sought and curetted if found. If there are no further signs of attic, antral, or mastoid disease, the operation is done. The wound should be allowed to fill with a blot-clot, the edges brought together, and in this position held either by sutures or by a pressure-pad. The after-treatment can be carried on most successfully through the auditory canal, as the operation permits inspection and direct medication of the attic and antrum, and affords greatly improved drainage of these formerly obstructed parts.

Many authorities teach that after cholesteatoma has been removed from the mastoid by operation as just described, a retro-auricular opening should be maintained at least until the former cholesteatomatous cavity is lined with true skin. But this is not advisable when the diseased cavity is not very large. In general it may be said that true skin is out of place, heterotopic, in a closed cavity like the mastoid. Therefore it appears more rational to treat cholesteatoma in the temporal bone by thorough removal of the heterologous mass, and healing the wound-cavity from the bottom without retro-auricular opening.

¹ Otological Section, Tenth International Medical Congress, Berlin, 1890.

Chronic Mastoiditis.—Chronic suppurative mastoiditis the result of chronic suppuration of the middle ear may, like the latter, continue a long time without caries and necrosis of either the medial or the lateral plate of the mastoid cavity. It may safely be assumed that in every case of chronic suppuration in the drum-cavity there is a concomitant suppuration in the antrum, and sometimes, also, in the mastoid cells. If the chronic tympanic suppuration can be controlled or cured, the lesions in the mastoid antrum are also cured at the same time. As has been said, ossiculectomy is the best way of curing chronic suppurative otitis and warding off or curing antrum disease. However, many cases of chronic suppuration are either not treated at all or improperly treated, and the mastoid cavity becomes more inflamed,—*i.e.*, its mucous membrane becomes more infiltrated and its drainage defective.

Symptoms.—The disease may now take one of two courses, rarely both. Pain in the mastoid, with headache and fever, without any external mastoid symptoms, may indicate an irruption of pus either into the lateral sinus and posterior cranial fossa or forward into the middle cranial fossa; or pain in the mastoid and fever may be followed by tenderness and swelling of the outer mastoid surface and spontaneous opening of the cortex, with escape of pus beneath the dense cutaneous tissues of the mastoid region.

Treatment.—An incision should be made and the pus evacuated. The osseous surface should then be fully exposed and the opening in the bone discovered. This should be followed, the bone well chiselled away, and the mastoid cavity thoroughly explored, all diseased tissue, both soft and hard, being removed. If the inner wall is intact, the cavity may be allowed to fill with blood (Blake), the wound drained and stitched, and healing by first intention sought. If, at the same time, all diseased tissues in the middle ear can be removed, entire recovery from the chronic purulency may be expected. If, after exposure of the mastoid and middle-ear cavities, a sinus is found leading to the cranial cavity, the mastoid operation is but preliminary to an operation upon the cranial cavity. No operation upon the encephalon for an otitic lesion can be considered complete until the antrum and middle ear have been opened, the pathway of disease from the ear to the brain sought and followed, and the septic *nidus* in the drum-cavity and the mastoid permanently removed.

The operative procedure in opening the mastoid and antrum cavities in chronic intramastoiditis, by means of hammer and chisel, resembles that described for trepanation of the mastoid in acute mastoiditis. It must be borne in mind, however, that in a case of acute intramastoiditis in an ear previously free from purulency we may find a much thinner cortex than would be found in a mastoid the seat of chronic purulency. In the first instance it is preferable to choose the point of trepanation at the suprameatal triangle and aim at once for the antrum (Fig. 11, *p*). We make no effort to expose the attic and middle ear and disturb the ossicles,

lest we destroy the hearing while arresting the purulency. In chronic purulent intramastoiditis, always a result of chronic purulency of the drum-cavity, the surgeon in chiselling open such a mastoid should follow any spontaneous opening in the cortex already present, or open at a discolored or softened spot in the cortex, and then aim for the antrum and middle ear, thoroughly explore the middle-ear cavities, and remove all diseased tissues, including the malleus and incus or their remnants, but never the stapes in any case. This bonelet is very resistant to suppuration, and hence prevents the entrance of pus from the middle ear to the internal ear and thence to the cranial cavity. To remove it in chronic suppuration of the middle ear would be to invite the entrance of pus to the internal ear and consequent grave disaster. Every mastoid cavity, and hence every case of intramastoiditis, varies from all others. The surgeon must, therefore, prepare to go slowly, picking his way until he has exposed enough of the outer wall of the mastoid to see his way to the antrum or to the mastoid cavity before reaching the antrum, as is often necessary in chronic intramastoiditis. It is hardly necessary to say that no one should attempt a radical operation on the mastoid unless he has had ample practice on the cadaver; and he should also be able to penetrate the cranial cavity by following a septic pathway from the middle ear and mastoid cavities, if one exist, and relieve the *nidus* in the brain cavity.

CHAPTER XIX.

OTITIC EXTRADURAL AND PERISINOUS ABSCESES.

IF the symptoms of otitic intracranial lesion are not grave, the surgeon may temporize in operating; but if they are urgent and life be threatened, he should operate at once. In the former conditions the mastoid should be opened first, the nature of the otitic disease discovered, and the presence or absence of complications in the adjacent parts of the temporal bone established. If the latter complications exist, the surgeon should proceed at once, if possible, to operate for their relief as soon as they are discovered by the exploratory operation on the mastoid. If they do not exist at that time, he should wait a few days to see the effect of his operation on the temporal bone. If there is urgent need of operation on the cranial cavity and brain, and the diagnosis is fully established, the surgeon may in some cases first perform a temporary resection on the cranium and treat the purulent disease in the ear by a later operation.

Symptoms of Otitic Intracranial Lesions.—If *optic neuritis* is found in connection with purulent inflammation of the ear, the diagnosis of extension of ear disease to the brain is certain, no matter whether other evidence exists or not (T. R. Pooley). But, unfortunately, optic neuritis does not explain the nature of the intracranial lesion. Marked optic neuritis alone, occurring in chronic otorrhœa, is sufficient indication for opening the mastoid, but optic neuritis as an indication for exploratory opening into the cranium in otitic lesions can be considered only in connection with other symptoms. Its occurrence, however, seems to render quite certain the presence of intracranial disease.

Extradural Otitic Suppuration.—An extradural otitic suppuration is one in which the dura is found more or less exposed and forming part of the wall of the purulent cavity in the mastoid. Such exposure of the dura, especially over the sinus, is so often an accidental discovery at the time of a mastoid operation, and is so seldom accompanied by any symptom leading to its suspected presence, that no special clinical significance can be attached to it. "This form of exposure of the dura must be considered the result of *erosion* of the bone from without inward, rather than the result of the eroding action of a true extradural abscess from within outward, upon the layer of bone dividing the abscess from the mastoid cavity. This is shown to be the course pursued by the disease, from the circumstance that the broken-down region in the bone sometimes has the form of a flat funnel, the larger circumference of which is directed towards the *mastoid* cavity. When the bone is destroyed as far as the dura, especially over the sinus, the surface of the latter is covered with

granulations, forming a protecting wall against the advance of the inflammation. These granulations participate in the suppuration, and hence in this sense we may speak of an extradural suppuration, or supuration of the outer surface of the dura" (Grunert). If, as soon as the mastoid cavity is opened, the pus escapes *with marked pulsations*, the surgeon may be sure that the dura beyond is exposed.

EXTRADURAL OTOGENOUS ABSCESES.

Extradural or epidural otogenous abscesses are collections of pus, of otitic origin, between the dura and the temporal bone. Such collections of pus form more frequently in connection with acute than with chronic purulent otitis media.

Symptoms and Diagnosis.—As a rule, fever is absent in uncomplicated extradural abscess. This is unfortunate for the patient, because his true condition may not be recognized. When fever is present the abscess will be found to be, as a rule, *extrasinous*. It must be borne in mind, however, that fever may be due to the aural inflammation and not to an intracranial lesion, especially when there is pus-retention in the ear. Therefore, whenever in a case of otitis media fever sets in after the ear can be excluded as the cause of the rise in temperature, the medical attendant is justified in suspecting an intracranial complication. *Uncomplicated otogenous brain-abscess* can now be excluded, as it produces no fever, as a rule.

Treatment.—As the prognosis in expectant treatment is very doubtful, and as spontaneous recovery of an extradural abscess of any size has never been observed, the only proper treatment is an operative one. However, the difficulty in determining the indication for operating is directly the result of the difficulty and uncertainty in making a diagnosis. A positive diagnosis is not made until the mastoid cavity is opened and the external pathway thus exposed followed to the intracranial collection of pus. "If in a mastoid operation we find no conducting-sinus, we are justified, when we suspect, on the strength of clinical observation, the possibility of the presence of an extradural abscess, in not hesitating to open the middle and posterior cranial fossæ and seek for the extradural pus" (Grunert). If in such a case no pus is found in the middle or posterior fossa it is best to await the result of the mastoid operation. If the deep-seated headache and other symptoms which have led to the probable diagnosis of the presence of an extradural abscess continue after the mastoid operation, one must bear in mind the possibility that the extradural pus, sought for in vain in the middle and posterior fossæ of the skull, may be on the posterior surface of the pyramidal part of the petrous bone or on its apex; and in such an instance the surgeon should endeavor to reach this deep-seated pus-collection by opening the cranial cavity immediately above the bony auditory canal and pushing away the dura from the petrous pyramid, as suggested by von Bergmann.

When the extradural abscess is finally reached, it must be opened as freely as possible by chiselling away the overlying bone coextensively with the diseased area of the dura. It will not be sufficient to remove only so much of the bone as corresponds to that portion of it from which the pus has lifted the dura, because the two areas do not always coincide, especially in diffuse extradural pus-collections in connection with chronic purulent otitis media. Scraping granulations from the dura is not advisable when these are of a dirty gray color, because in such a procedure, especially when the granulations are located on the sinus, even with great care in using the curette, there is danger not only of mechanical infection of the soft meninges, but also, when the sinus is implicated, of hemorrhage from the latter. *The abscess-cavity clears itself after it is opened and packed*, so that, as a rule, by the first or second change of dressing the dura mater at the bottom of the abscess-cavity assumes the appearance of a fresh wound-surface. The results of treatment of uncomplicated otogenous extradural abscess, in connection with acute otitis media, are extremely favorable (91.7 per cent., Grunert); less so in chronic cases. Entire cure in these cases of otogenous extradural abscess includes entire healing of the causative ear disease.

Deep-lying extradural abscesses, which originate chiefly from irruption of pus through the semicircular canals, but sometimes from conveyance of pus along the course of the facial and major superficial petrosal nerves, usually have their centre at the point where the posterior limbs of the vertical semicircular canals unite, and burrow along the upper posterior edge of the pyramid, sometimes inward and sometimes outward. Nearly all cases of this kind, as observed by Jansen, originated in *acute otitis media*.

Treatment.—In such cases the upper wall of the pyramid as far as the superior semicircular canal, the posterior upper edge of the same for a like distance, and also the adjoining posterior wall should be removed with bone-forceps as far as the labyrinth core. In order to insure undisturbed healing and avoid deep burrowing of pus along the acoustic nerve, it is best to follow the exposure of *deep labyrinth abscesses by opening the vestibule*. This can be best done by the removal of the posterior half or two-thirds of the semicircular canal from behind and above downward by means of narrow, straight chisels. If necessary, the lower posterior semicircular canal may also be partly or entirely removed and then the vestibule laid open, from behind forward, by removing the posterior half of the horizontal semicircular canal.

Perisinous abscesses have generally been exposed by opening the posterior cranial fossa after chiselling open the mastoid process. In a few instances they have been opened through the middle cranial fossa. In cases in which the mastoid abscess and the purulent centres in the sinus form one pus-cavity, the latter has been opened and drained by the one operation on the mastoid. When this is not the form of the perisinous ab-

abscess, the procedure should consist in opening the mastoid and antrum, then chiselling away the posterior bony wall of the mastoid cavity, the anterior lateral wall of the sinus is brought to view. Then exploration of the sinus must be carried on until healthy tissue is reached. Explorations about the sinus lying deep in the cranial cavity are reached after removal of the inner and posterior wall of the mastoid in its extent, best accomplished with chisels and long-bladed bone-forceps. If the abscess extends as far as the jugular foramen, it must be pursued by chiselling away the transverse sinus and, when necessary, removing part of the floor of the posterior cranial fossa. If the part of the wall first exposed is free from disease, then the posterior cranial fossa must be further opened so as to permit the removal by a raspator of the sinus and the dura from the posterior surface of the petrous bone. If no pus is found here, and yet the symptoms of a purulent focus in the posterior cranial fossa continue, it is deemed necessary to explore the upper knee of the sigmoid portion of the sinus and that part of its anterior horizontal course near it. If pus then gushes from the posterior fossa, or if with continuing symptoms of intracranial suppuration the posterior fossa is found free from pus, the middle fossa must be opened from the cranial surface, preferably above the linea temporalis. The opening of the middle cranial fossa is begun by removing the lower part of the squama, inspection of the entire upper surface of the petrous bone is made easier (Jansen). The initial opening should be made with a crown trephine close above the posterior wall of the auditory meatus and reach backward and forward for several centimetres as required. Bone-forceps are best adapted for the enlargement of this opening.

CHAPTER XX.

OTITIC PHLEBITIS, THROMBOSIS, AND PYÆMIA.

Symptoms.—Dilatation of the veins of the scalp is considered by Ler-moyez¹ to be a pathognomonic symptom of thrombosis of the superior longitudinal sinus. In a case that he reports, "this dilatation, which could be seen only after the scalp was shaved for operation, affected all the superficial veins of the skull, in the right as well as the left side, and formed a kind of 'Medusa's head,' such as is seen in the belly of old cirrhotics." *Optic neuritis* is usually not observed, or only slightly marked, in uncomplicated sinus-thrombosis; it is sometimes found in connection with extradural abscess. *Headache* is usually wanting in uncomplicated sinus-thrombosis. *Rigidity of the neck* may be found in septic thrombosis of the sinus. *Difficulty of deglutition*, when not dependent upon pharyngeal inflammation, indicates thrombosis of the sinus and deserves more attention than it obtains; it is probably more frequently present than is supposed (Gradenigo). *Vertigo* and *nausea* are also observed in connection with uncomplicated sinus-thrombosis. The *fever* in sinus-thrombosis usually assumes the pyæmic type; it may, however, be constant and not pyæmic in type. The patellar and superficial reflexes are unchanged in uncomplicated sinus-thrombosis.

Whiting, in his valuable brochure,² gives three clinical stages of sinus-thrombosis, as follows:

First Stage.—The presence of a thrombus, parietal or complete (chiefly composed of fibrin, red blood-cells, exfoliated endothelium, leucocytes, and homogeneous protoplasmic cells), not having undergone disintegration and accompanied by slight or moderate pyrexia, rigors being usually insignificant or absent.

Second Stage.—The presence of a thrombus, parietal or complete, which has undergone disintegration with resulting systemic absorption, characterized by frequent rigors and pronounced septico-pyæmic fluctuations of temperature.

Third Stage.—The presence of a thrombus, parietal or complete, which has undergone disintegration with systemic absorption, accompanied by rigors, rapid and great fluctuations of temperature and central or peripheral embolic metastases, terminating usually in septic pneumonia, enteritis, or meningitis.

The *diagnosis* of the *first* stage, owing to the indeterminate symptoms up to this point, is rarely made until an operation for mastoiditis is per-

¹ Ann. des Mal. de l'Oreille, December, 1897.

² Archives of Otolaryngology, December, 1898.

formed. In this stage recovery is still possible, though not probable without operation upon the sinus, for the thrombus must now be considered as infective. The only safeguard against the *second* stage is to operate immediately upon recognition of the *first* stage. The prognosis in the first stage is highly favorable, while in the second stage it is very much less so, on account of the systemic affection now present and the operative risks. The period of transition between the first and second stages is generally brief, and its completion is usually heralded by a sharp rigor.

The *diagnosis* of the *second* stage is established by symptoms that cannot be attributed simply to a suppurative inflammation of the middle ear, but can be dependent upon nothing but an otitic septic involvement of the sinus.

The *diagnosis* of the *third* stage is "to the practical observer distressingly clear." All the symptoms of the second stage are increased by the additional symptoms resulting from the dissemination of septic emboli and the occurrence of embolic metastases. However, even in the midst of these symptoms, including septic enteritis and acute septic parenchymatous nephritis, *recovery has taken place* in some of the cases operated upon by Whiting.

All authorities now deem prompt exploratory exposure of the sinus in suspected sinus-phlebitis entirely justifiable and much more advantageous to the patient than waiting for positive symptoms of the presence of sinus-thrombosis, when it is generally too late to operate with hope of relief.

Treatment.—The region to be operated upon and its relation to contiguous aural and cerebral structures may be seen in Fig. 86. The preliminary steps to an operation upon the sigmoid sinus are like those for the usual mastoid operation.

The sigmoid groove may be quickly and conveniently opened with a curette or a rongeur, but never with a chisel and hammer. The rongeur used for this purpose should be as broad as possible at its beak. The most accessible part of the sigmoid groove for opening is the knee and descending portion below it.

The knee lies about at the level of the suprameatal spine, and usually from one-half to two-thirds of an inch posterior to it. If the mastoid is markedly prominent and convex, it is then what is known as a "dangerous mastoid," because the groove for the sinus will be found to be superficial,—*i.e.*, near the posterior wall of the external auditory canal,—while when the mastoid process is broad and flat, the sinus usually lies quite far behind the posterior wall of the external auditory canal. After the groove of the sinus is opened, further exposure of the sinus either way is best accomplished with a rongeur, the chisel and hammer being used only to remove the outer table of the skull, which is too thick to be removed by means of the rongeur. All carious bone must be

PLATE VI.

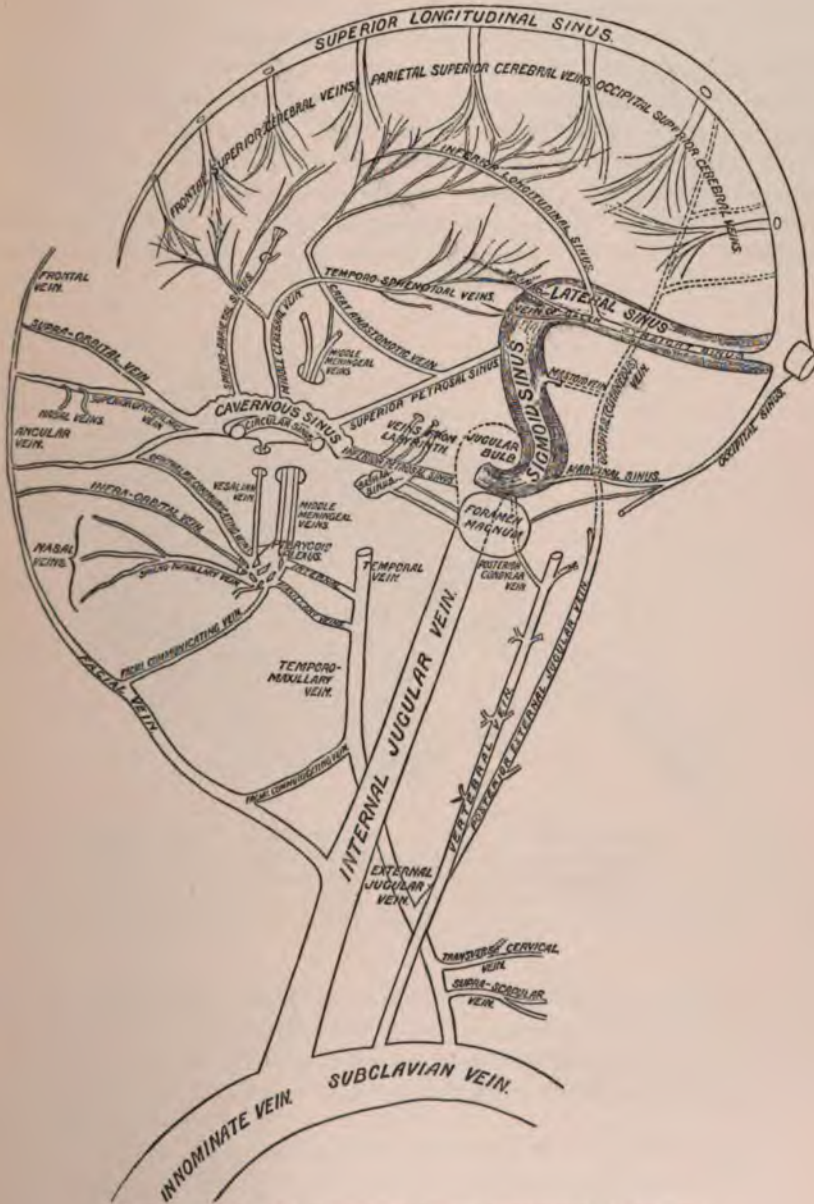
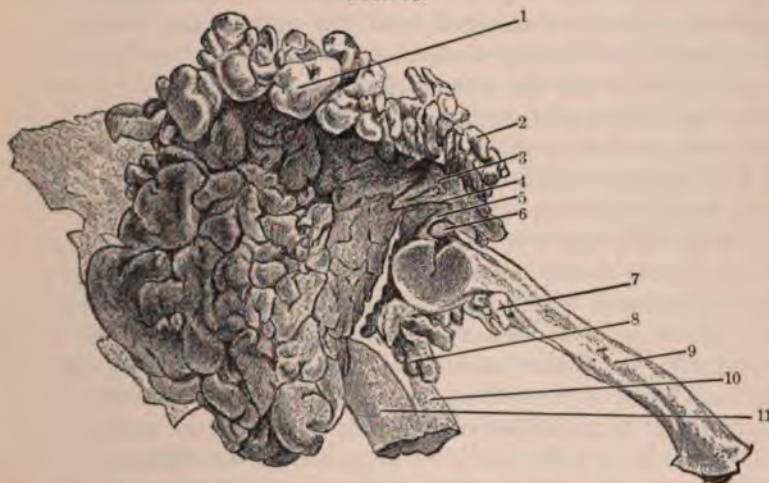


Diagram of intra- and extracranial venous anastomosis. (Macewen.)

removed, *no matter how far such interference may lead*. Operation on the sigmoid sinus cannot be properly performed if less than *two inches* of its bony covering be removed. As much as this should be removed whether the bone is diseased or not throughout this length.

Chipault and Lambotte¹ have removed the bone and the sinus, after ligation of the jugular, from the bulb to the torcular, the patient recovering entirely. Downward, it will serve all purposes to remove the groove as far as including the external margin of the jugular foramen, great care being taken to avoid the posterior condylar foramen behind and the lower third of the Fallopian canal in front. In most instances the thrombus is situated in the descending portion of the sigmoid sinus

FIG. 86.



Cast of the middle ear and mastoid, seen from without. (F. Siebenmann.) 1, upper external horizontal cells, squamomastoid; 2, anterior upper horizontal cells, squamomastoid; 3, upper malleo-incudal space, attic; 4, external malleo-incudal fold; 5, lower malleo-incudo-squamous space, lower attic; 6, upper pouch of the membrana; 7, tubal cells; 8, tympanic cells, floor of drum-cavity over the jugular bulb; 9, Eustachian tube; 10, petrosal sinus, and 11, transverse sinus, lying together in the jugular fossa.

extending to the knee, rarely far beyond it into the lateral sinus, and thence downward towards the bulb, and sometimes farther downward into the jugular vein. Knapp observed a case of thrombosis of the left lateral sinus which extended all the way around through the torcular to the right lateral sinus.

When the thrombus is incomplete or parietal, it is hard to recognize. As blood still flows through the sinus, the aspirating needle is of no assistance. Inspection will not aid, as there is no bulging. Palpation must be depended upon, for it will reveal the fact that the sinus-wall will

¹ Ann. des Mal. de l'Oreille, 1899.

dimple like a bladder filled with water, and is equally tense in all directions. Pressure with the finger-tip over the parietal clot will impart a sensation to the finger of contact with "a thickened tissue under which lies an unevenly distributed, yielding substance" (Whiting).

Before an incision is made in the exposed sinus, it is imperative to obstruct the flow of blood both below and above, so that the hemorrhage may not be excessive, as it will occur from both directions at the same time. The sinus should now be incised in its long axis to an extent sufficient to admit of the convenient introduction and manipulation of a curette, with which the clot should be thoroughly and rapidly removed. Some bleeding should be permitted, as it will wash out particles of the clot not removed by the curette. Every vestige of clot must be removed and the circulation thoroughly re-established, or sepsis will continue, and another operation be demanded after the patient has become weaker. As the parietal and visceral walls of the sinus may be very close together, the initial incision into the sinus must be made cautiously, or the visceral wall and the brain may be wounded. After controlling the hemorrhage, the entire wound-cavity should be filled with gauze, covered with cotton, and a firm bandage applied; or "gauze may be packed firmly upon the opening in the sinus and the flap of the skin wound stitched down upon the packing with heavy sutures" (Whiting). The stitches may be removed in twenty-four hours or later, as demanded by expediency.

In considering a completely obstructing thrombus at the knee of the sigmoid sinus, or in its vicinity above or below, Whiting¹ states that in this condition "the sinus lacks its characteristic smoothness and lustre, and is seen to be distended and generally darkly discolored at the site of the clot, and granulations may or may not cover the walls. The presence or absence of pulsation is of no material significance. The sinus has a doughy feeling if the clot is fresh; or it is firm, tense, and resisting if the clot is older and contains granulations. In such a case the sinus should be freely exposed above and below the obstruction, and pressure made upon it both at the distal and proximal ends of the clot. The incision must be sufficient to admit easily and freely a small curette. When the thrombus is recognized early in its formation, while it is soft and non-adherent, a short incision is ample, as the clot will be forced by the blood-pressure in the sinus and the elasticity of the meninges behind it through the opening thus made. When a small, firm obstruction exists, the sinus should be very carefully scrutinized between the clot and the bulb, so that any respiratory movements of its walls may be detected, for in case of aspiration of the jugular bulb and sinus below the thrombus, danger of aërial embolism is to be apprehended, unless the precaution of ligating the jugular preliminary to opening the sinus is observed." It is said that air embolism of the sinus or jugular may be prevented by

¹ Loc. cit.

pressure at the bulb is removed, and the sinus does not refill, it becomes plain that the obstruction is in the bulb or below it, in the jugular vein. In such a case, the finger-pressure at the knee being removed and the sinus being immediately filled with blood, the operator is assured that there is no obstruction on the torcular side. In this experiment all expressive movements should be made from the bulb towards the torcular, to prevent the risk of forcing particles of the clot into the jugular.

In "extreme cases" in which infection has extended into the jugular and has resulted in septic phlebitis, possibly suppurative in character, it will be manifestly impossible to re-establish the circulation in that direction. Hence, in order to anticipate or prevent *dissemination of septic matter*, the jugular vein must be ligated as low down as possible near the clavicle and also high up, as near as possible to the bulb, and the jugular resected and removed entire from the neck. The jugular bulb should then be syringed thoroughly, but not too forcibly, with a solution of bichloride (1 to 5000), the stream being directed downward into the bulb through the incision already made for curetting. Forcible upward syringing from the neck into the bulb may easily wash septic matter through its softened visceral wall into the subdural or subarachnoid spaces. In this operation, at the moment of opening the sinus-wall the foot of the operating-table should be appreciably elevated, in order to increase the blood-pressure in the dural sinuses, and thus diminish the risks of the admission of air into the open vein. *Aspirating puncture* of the sinus is of little value, even in simple cases; it is only confirmatory of other diagnostic signs. It is valueless in parietal thrombosis and obstruction in the bulb and upper jugular. The operation on the sinus always requires plenty of time for its successful performance.

The plan presented for the exposure of perisinous abscesses may be pursued in laying bare the diseased sinus. The thrombotic part of the sinus should be opened forward and downward until undischored thrombosis is reached, if necessary as far as the jugular foramen. Backward it is better to expose the sinus a few centimetres farther than the thrombus extends.

Thrombosis of the Cavernous Sinus.—Koerner has shown that this form of thrombosis is due frequently to the passage of infection from the middle ear, by way of the carotid canal, to the cavernous sinus. The occurrence of œdema about the brow and orbit, exophthalmos, paralysis of the ocular muscles, immobility of the eyeball, œdema of the lids, chemosis of the conjunctiva, and choked disk on the side of the chronic aural sup-puration indicate thrombosis of the *cavernous sinus*.

Treatment.—The treatment consists in prompt surgical exposure of the middle-ear cavities, opening freely the *lateral* sinus and permitting judicious hemorrhage in the hope that the forcible blood-current in the sinuses will eject the thrombus either at the artificial opening in the lateral sinus or throw it into the general circulation, when, if not infectious, it may be dissolved without metastases (O. Brieger).

CHAPTER XXI.

OTTIC CEREBRAL AND CEREBELLAR ABSCESS AND MENINGITIS.

OTTIC CEREBRAL ABSCESS.

Symptoms.—Optic neuritis is frequently found in otitic cerebral abscess, as well as in extradural abscess. Headache is always present with cerebral abscess. Slowness of the pulse may be observed in this disease, but is not always present. Fever does not usually appear in cerebral abscess until near the end, and is generally high. Patellar and superficial reflexes are exaggerated in cerebral abscess, especially on the side opposite the lesion.

Small abscesses in the temporal lobes may run their course without central symptoms, as shown by Oppenheim.¹ Optic acoustic aphasia is the usual symptom of abscess in the left temporal lobe. The same symptom may be present in abscess in the *right* temporal lobe of a *left-handed* subject. The diagnosis of an abscess in the right temporal lobe is far more difficult than in one of the left, since the physician must be guided by the existence or discovery of so-called indirect symptoms or symptoms of contiguity. Ptosis of the left upper eyelid has been observed in connection with an otitic abscess of the left temporal lobe (Steinbrügge). The latter symptom is supposed to be due to pressure of the abscess upon the trunk of the oculomotor nerve close to the insertion of the tentorium cerebelli, where it passes beneath the dura, and is considered to be a valuable symptom of the presence of an abscess in the temporal lobe when it occurs on the side of the affected ear.

Among the symptoms of otitic cerebral abscess may be named vertigo, staggering, nausea, dysphasia, violent headaches, and hemiparesis of the opposite side, without rise of temperature. Sensory aphasia and homonymous hemianopsia with preservation of the pupillary reaction points to the temporal lobe as the seat of the abscess. *Amnesic* aphasia is considered a symptom of abscess in the left temporal lobe. An otitic abscess in the temporosphenoidal lobe may present mixed symptoms, as, for example, aphasic symptoms, those of brain-abscess, in conjunction with chills, high temperature, rapid pulse, and convulsions,—*i.e.*, symptoms of thrombosis of the lateral sinus rather than of brain-abscess,—as in a case reported by G. Bacon.² The aphasic symptoms, however, lead to the diagnosis of brain-abscess.

Symptoms of extradural abscess or of sigmoid sinus-thrombosis always

¹ Nothnagel, Spec. Path. u. Therap., 1897.

² Transact. Amer. Otol. Soc., July, 1896.

dominate and mask those of brain-abscess when they occur together, and it is not until the former condition has been relieved that reliable evidence of the pressure of a brain-abscess can be obtained. Hemiplegia is a symptom that the contents of the brain-abscess press upon the internal capsule. Involvement of the third nerve is a symptom of temporo-sphenoidal abscess; sometimes the sixth nerve is involved in the same lesion.

Nearly all otitic brain-abscesses are situated very near the spot of original suppuration in the middle ear or petrous bone, and often in demonstrable connection therewith. Since when the abscess is in the temporal lobe the tegmen tympani and tegmen antri are diseased and the abscess lies with its fundus against the dura, it is possible in many instances to unite the emptying of the abscess with removal of diseased bone in the middle-ear cavities.

Brain-abscesses may be *bicameral*, or *multiple* and *discrete*. The former have been noted in the temporal lobe, and the latter may be, one in the temporal and one in the occipital lobe of the same side. Usually their existence in either form is not discovered until an autopsy. Multiple discrete abscesses may occur in the cerebellum,—viz., one in the right lobe and one in the processus vermiformis (Heiman).

In bicameral cerebral abscess a fistula may be found communicating with the ventricle and associated with optic aphasia. Manasse¹ records such an occurrence in a woman of forty-two, the subject of chronic purulency of the ear, successfully relieved by operation. Spontaneous external discharge of a cerebral abscess may occur, as reported by Urbantschitsch.² The discharge took place through the tegmen tympani, the middle ear, and a mastoid opening.

Sudden vertigo, titubation, intense headache, hemiparesis, aphasia of conductivity without verbal deafness, and lateral homonymous hemianopsia on the affected side, with conservation of pupillary reflex in a subject of chronic purulent otorrhœa, have been shown to be symptoms of an otitic abscess in the *occipital* lobe (Lannois and Joboulay). According to these authors, the aphasia of otitic cerebral abscess is oftener an aphasia of conductivity than a pure motor aphasia.

A bicameral otogenous abscess may occur in the *occipital* lobe, as shown by J. Morf,³ and a simple otogenous abscess of the *occipital* lobe may rupture into the lateral ventricle, paralyzing the breathing centre, as reported by Grunert.⁴ In this the slow pulse did not appear till near the end, as there had been continued fever from the cerebritis about the abscess.

¹ Arch. f. Otol., April, 1898.

² Austrian Otol. Soc., November 30, 1897.

³ Arch. f. Otol., July, 1897.

⁴ Arch. f. Ohrenh., December 30, 1897.

Histological Seat.—In seeking an explanation of the great variety and difference in the symptoms of brain-abscesses we must first bear in mind the *histological seat* of the abscess,—i.e., whether the abscess is seated in the *brain-tissue* itself or in its *connective-tissue framework*; also whether we have before us in a given case a breaking down of brain-tissue, a *destructive* process, or a collection of new-formed pus in the connective-tissue framework of the brain,—i.e., a *productive* process.¹ This leads at once to the classification of brain-abscesses into two kinds,—viz., the *parenchymatous* and the *interstitial*. The first form is really an abscess of the brain; the second is an abscess in the brain. The *parenchymatous brain-abscess* must be considered the result of a purulent breakdown or gangrenous destruction of the brain substance,—a degenerative or destructive process induced by the incursion of infectious matter from the suppurating ear. The contents of such an abscess are not true pus, but *ichor*.

The *interstitial brain-abscess* is the product of an inflammatory process set up in the interstitial connective tissue by pathogenic germs coming from the aural suppuration. It is therefore a “productive or a formative, or an exudative process,” and inflammatory new formation and increase of this connective tissue, with escape of pus-cells into the inflamed region and consequent formation of a new focus of pure pus, are characteristic of this condition. In a parenchymatous abscess, therefore, something previously present is destroyed or transformed, whereas in an interstitial abscess something not heretofore existent is formed and added to the normal contents of the cranial cavity.

Why the irritants arising from the neighboring aural suppuration sometimes produce a *parenchymatous* and sometimes an *interstitial* brain-abscess depends probably upon the *kind* of invading irritant. If this belongs to the class of pus-producing cocci, an interstitial suppuration will be the result of its invasion of the brain; if the bacteria of decomposition pass from the ear to the cranial cavity, gangrenous destruction in the part invaded by them will be the result. The contents of the parenchymatous abscess possess great fetor, being ichor; the contents of the interstitial abscess, being pus, are odorless, or nearly so. The interstitial abscess has a connective-tissue membrane or capsule. The parenchymatous abscess has no connective-tissue capsule, but at best is surrounded only by an infiltrated thick wall not separated from the adjacent brain substance by any connective tissue. Such a surrounding wall might be termed an “ichorogenous” membrane. These differences in the nature of the surrounding walls of the two kinds of brain-abscess account for certain clinical differences observed in the two kinds.

Fever.—The parenchymatous abscess runs its course *without fever*, since its occurrence is not a true inflammatory process. In fact, there may be

¹ R. Müller, Arch. f. Ohrenheilkunde, September 20, 1900.

with it subnormal temperatures, as is often observed in brain-abscesses, or there may occur, when the ichorous matters get into the lymph and blood-channels, fever of a markedly ichoræmic or septicæmic character, as is also sometimes seen in brain-abscess.

An interstitial brain-abscess, however, being the result of an inflammatory process, is always accompanied by fever, which, however, in consequence of the small extent of the inflammatory focus compared to the size of the entire body, is only slight, and if there are no other fever-producing factors present, it will be limited to an evening body temperature of 37.2° , 37.8° , or 38° C., as is often observed in cases of brain-abscess.

Brain-Pressure.—The most important difference between both kinds of abscess lies, however, in the symptoms of increased brain-pressure. As the interstitial brain-abscess is attended with the formation of new elements in the brain, the latter remaining undiminished, it must be attended at once with increase of intracranial pressure, whereas the parenchymatous abscess being formed by the breaking down of brain-tissue and the assumption of the place of the destroyed brain by ichorous material, the latter equals the quantity of the former, the brain space is not encroached upon, and there is no increase of intracranial pressure. Hence a retarded pulse, general headache, general percussion tenderness of the skull, a sensation as though the head would burst, choked disks on *both sides*, mydriasis on *both sides*, nausea and vomiting, aphasic symptoms at first, somnolence and unconsciousness in the later stages, are all symptoms to be expected in interstitial brain-abscess, while in a parenchymatous abscess we shall not find them, as a rule. Symptoms of brain-pressure may, however, be observed with the latter form of brain-abscess; but these are not the result of general but of *local brain-pressure*. The pus focus formed by the parenchymatous abscess acts like a foreign body on the subjacent brain-tissue. Hence we observe as symptoms of *local pressure* ocular congestion, especially when the seat of the abscess is in the cerebellum, mydriasis, well-marked tenderness on percussion of the temporal region or the occiput, and disturbances in the tracts of certain nerves on the side of the abscess. These localized pressure-symptoms are specially characteristic of the parenchymatous abscess, although they may to some extent appear in connection with interstitial abscesses.

The *pulse* is retarded by an increase in the general intracranial pressure, while brain-pressure confined to one side affects the central territory of the right or the left vagus nerve, and is followed by *irregularity* of the pulse. *Slowness* of the pulse should indicate rather the presence of an interstitial abscess, while the irregular pulse should indicate the existence of a parenchymatous abscess, provided there are other symptoms of the existence of a brain-abscess. Unilateral displacement of intracranial pressure-conditions is also induced by extradural pus-collections, and therefore in such diseases an irregular pulse is observed, and consti-

tutes a positive symptom of an extradural abscess when there is entire absence of symptoms of brain-abscess.

In conclusion, it must be said that the parenchymatous abscess shows more central symptoms, while the interstitial abscess manifests more general symptoms. This is due to the fact that in the former, in addition to the symptoms of local pressure, there are added those due to the destruction of the corresponding centres or certain conducting and connecting paths.

The value of operation, and the prognosis, differ markedly in the two forms of brain-abscess. *In general the prognosis as to restoration of function, and as to life, is more favorable in the interstitial than in the parenchymatous abscess.*

Mixed Form of Abscess.—Very rarely a brain-abscess is found conforming strictly in its symptoms to either one of the above descriptions: an abscess originally parenchymatous may produce in its neighborhood an interstitial abscess, or the latter form of brain-abscess may lead to the formation of a gangrenous spot in the brain substance, resulting in a parenchymatous abscess. Therefore, as one of these events happens in the majority of cases, we are usually confronted with a *mixed form* of brain-abscess, though the abscess originally very probably conformed strictly to either the parenchymatous or the interstitial form.

Müller¹ also calls attention to a symptom sometimes observed in brain-abscess,—viz., a stiff way of holding the head, which might be confused with the true stiff nucha of meningitis. If a patient with a cerebral abscess is able to walk or move, he holds his head bent stiffly backward in order to prevent any increase in his headache by motion of his head.

Treatment.—Abscess of the brain has been opened and drained successfully by way of the mastoid and middle ear, as shown by Coville and Lombard.²

In otitic abscesses of the temporal lobe the surgeon rarely finds the point of transition of the pus from the temporal bone to the brain, although the position of such abscesses is directly over the tegmen tympani. In such cases the posterior and upper part of the inner wall of the mastoid should be removed as far as the labyrinth, the latter being left intact. Then a portion of the squama and the entire tegmen tympani should be removed, and the operator may penetrate as far forward as the tympanic mouth of the Eustachian tube and the tympanic wall of the cochlea. In all otitic intracranial lesions it is considered best to choose the way of entrance through the mastoid and middle-ear cavities, because exposure and inspection of these cavities may furnish excellent indications for deeper operations.

¹ Loc. cit.

² Ann. des Mal. de l'Oreille, November, 1898.

OTITIC CEREBELLAR ABSCESS.

Prominent symptoms of otitic cerebellar abscess (perhaps for weeks) are intense though intermittent pain in the occiput, stiff neck, nausea and vomiting, subnormal temperature, and varying width of the pupils, the wider being on the side of the abscess in the cerebellum.

Increased knee-jerk on the side of the diseased ear, and cerebellar abscess may be considered a characteristic symptom; also muscular weakness, chiefly of the arm on the side of the diseased ear, and conjugate deviation of the eyes towards the unaffected side from weakness of the ocular muscles, may be considered symptoms of the presence of a cerebellar abscess. There may also occur horizontal nystagmus and paralysis of the sixth nerve on the side of the diseased ear in otitic cerebellar abscess. Sometimes the intense headache in the region of the occiput is increased by percussion, especially over the region of the cerebellar abscess. There may be also choked disk, inability to close the eyelid, and slight facial paralysis on the affected side. The tongue will be protruded in some cases towards the unaffected side, and the speech may be slow and indistinct. In a sitting posture the head may fall forward, then turn towards the unaffected side and continue to move with pendulum-like oscillations. The vertigo is intense in such cases, being excited by moving the head. Caries of the sigmoid groove, with thrombus of the sinus, or a purulent labyrinthitis, in a case of suspected brain-abscess, will indicate that the purulent collection is probably in the cerebellum.

Double optic neuritis is often the only pathognomonic symptom of a lesion in the posterior cranial fossæ. It is very likely to be present in cerebellar tumors and otitic cerebellar abscesses, because such lesions readily interfere with the circulation of the cavernous sinuses and ophthalmic veins. Very often double optic neuritis is the only positive symptom of otitic cerebellar abscess; but the eye-grounds may remain normal even in fatal cerebellar abscess, as shown by Woodward.¹

Morbid Growths in the Cerebellum.—Symptoms of morbid growths in the cerebellum, in connection with chronic otorrhœa, may be mistaken for those of otitic cerebral abscess. But in these cases the *slow onset* and continuance of the symptoms—headache, vomiting, low temperature, choked disks *on both sides*—point to the probable presence of a morbid growth in the cerebellum rather than to an otitic abscess in that region.

OTITIC MENINGITIS.

Basilar meningitis may follow purulent otitis media from invasion of the cranial cavity through the cochlea and internal auditory meatus.

Beach² calls attention to the important fact that a chronic purulency

¹ Arch. f. Otol., January, 1896.

² Jour. Amer. Med. Assoc., May 6, 1896.

in the ear or nose may be a source of infection of the brain-cavity in fracture of the skull, if the latter communicate in any way with the nasal cavities or temporal bone and middle ear. He asserts that many cases of fractured cranium might recover had they not been affected with chronic purulent ear disease before the fracture of the skull occurred.

Acute diffuse suppurative pachymeningitis is generally regarded as beyond surgical skill. Those cases of otitic meningitis reported as cured were evidently instances of acute circumscribed purulent pachymeningitis.

Acute Serous Meningitis.—Acute serous meningitis is not infrequently caused by purulent otitis media. Boenninghaus¹ describes two forms of acute serous meningitis, first noted by Quinke,—viz., a *malignant* form, a meningo-encephalitis, that runs a rapid and fatal course, in which death occurs before the exudation can become purulent; and a *benignant* form, in which the inflammation is limited to the pia and ventricles. The exudation remains serous. Lumbar puncture does no good in these cases. Puncture of the ventricles, however, is indicated. Not only does the latter procedure give relief, but in some cases simply opening the dura and the consequent brain prolapse relieve choked ventricles. Kretschmann² reports a case of serous meningitis originating from cholesteatoma of the middle ear relieved by operation.

AFFECTIONS OF THE INTERNAL EAR.

Carious and Traumatic Lesions of the Labyrinth.—The chief symptom in all cases of the above-named lesions³ is vertigo, with or without simultaneous nystagmus, sixty per cent. of the cases manifesting vertigo alone, and twenty-two per cent. of them with it a simultaneous nystagmus. Why some cases of carious defect in the labyrinth show vertiginous symptoms and others do not cannot be explained. In seventeen cases of traumatic opening of the labyrinth, only once was vertigo absent. In such cases the vertigo is held to be due to negative pressure in the labyrinth induced by the escape of the labyrinth fluid and collapse of the membranous labyrinth.

Traumatism of the Internal Ear.—Ménière's symptoms following traumatic lesion of the labyrinth have been observed by Politzer⁴ in a case of fracture of both temporal bones, involving the labyrinths. After death had occurred in the course of six weeks, from meningitis, a new growth of connective tissue in both labyrinths was detected by microscopic examination. Politzer believes that the rapid and incurable deafness occurring in various kinds of panotitis can be explained by the de-

¹ Arch. f. Ohrenh., December 17, 1897.

² Münch. Med. Woch., No. 16, 1896.

³ Lucae, Arch. f. Ohrenh., September 29, 1899.

⁴ Arch. f. Ohrenh., December, 1896.

velopment of a new growth of connective tissue in the labyrinth, and this fact explains why even prompt and energetic absorptive treatment fails entirely in such cases. In some instances the deafness caused by violence offered to the head is supposed to be due to *traumatic apoplexy* in the labyrinth terminating in degeneration, necrosis, and secondary hemorrhages in the internal ear. The author believes that many cases of drowning from so-called *sudden cramps* are in reality deaths from incapacitating ear-vertigo from sudden entrance of cold water into the ear. Such an accident is all the more likely to occur if the membrana tympani be perforated, as the cold water easily impresses the internal ear. It is worthy of note that in cases of drowning from so-called "cramps" the victim is generally seen to throw up his arms in his struggles; he cannot, therefore, be cramped in his arms or trunk. It has always seemed to the author that these struggles of the drowning man were due to his effort to regain his bearings, which had been lost by the disturbed equilibrium induced by irritation of the labyrinth from the sudden entrance of cold water into the ear.

Internal Ear in Submarine Laborers.—Apoplectiform affections of the labyrinth are said to occur in men employed in submarine caissons. When the Eustachian tube is permeable, the ear endures the increased atmospheric pressure in submarine caissons, but when this tube is not permeable, the inward pressure of the membrana, finding no recoil of air through the Eustachian tube, produces congestion of the drum-cavity and finally of the internal ear (F. Alt).

Syphilis of the Internal Ear.—A form of acute syphilitic affection of the ear, probably due to an effusion into the labyrinth in a previously normal ear, characterized by sudden deafness, tinnitus, and vertigo, coming on in the late secondary or early tertiary stage of systemic syphilis, is described by E. A. Crockett.¹ The difference between this form of sudden deafness, tinnitus, and vertigo and that due to non-syphilitic causes is that the *deafness is not so profound* in the specific form. This syphilitic aural affection yields promptly to a few doses of pilocarpine (one-sixth grain) given hypodermically, whereas non-syphilitic labyrinth diseases are entirely unaffected by pilocarpine. In fact, pilocarpine gives the best results in syphilitic diseases of the internal ear.

Tuberculous disease of the temporal bone may terminate in extensive destruction of the mastoid, the lower part of the squama, the petrous pyramid, and partial thrombosis of the superior petrosal and sigmoid sinuses, with tuberculous disease of the sphenoid and occipital bones (Barnick).

Internal Ear in Leukæmia.—In leukæmia the internal ear is often affected by profound and sudden deafness, sometimes accompanied by so-called Ménière's symptoms.

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DISEASES OF THE NOSE AND NASOPHARYNX.

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CHAPTER I.

ANATOMY AND PHYSIOLOGY OF THE NOSE AND NASOPHARYNX.

ANATOMY AND PHYSIOLOGY OF THE NOSE.

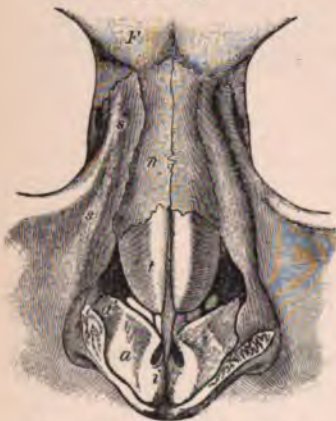
THE description of the anatomy of the nose includes that of the external or facial nose, the internal nasal passages, or nasal fossæ, and the bony air-cavities adjoining these, called the accessory sinuses.

The External Nose.—In considering the outward appearance of this, one speaks of the root of the nose, *radix nasi*, which is the part lying between the inner canthi of the lids; the *alæ nasi*, which are the movable wing-like portions bounding the nostrils externally; the *apex nasi*, or tip of the nose; the *dorsum nasi*, or back of the nose, extending from the tip to the root; and the *sella nasi*, or saddle of the nose, which is the depression where the back of the nose joins the forehead. The *alæ nasi*, or wings of the nose, are bounded above by a furrow called the sulcus alaris, below by the opening of the nostril, and posteriorly by the groove between the nose and cheek, called the sulcus nasolabialis. The internal boundary of the nostrils is formed by the ponticulus nasi, which forms the lower border of the nasal septum's unattached portion.

Skeleton of the External Nose.—This consists of the nasal bones, the nasal processes of the superior maxillæ, and the premaxillary portion of the upper jaw, the so-called pars incisiva. The nasal bones form the bridge of the nose. They articulate above with the nasal process of the frontal bone; their outer borders join the nasal processes of the upper jaw. At their inner margins the nasal bones join to form a median crest for junction

with the nasal spine of the frontal bone above, below this with the vertical plate of the ethmoid bone and the septal cartilage. The posterior surface of the nasal bones presents a longitudinal groove for the nasal nerve. The external surface of the nasal process of the superior maxilla is smooth; its inner surface presents two crests for the attachment of the middle and inferior turbinated bones (*crista conchalis superior et inferior*). Above, the inner surface joins the ethmoid bone, closing a part of the anterior ethmoidal cells. The upper border of the nasal process of the upper jaw articulates with the frontal, the anterior border with the nasal bone. Posteriorly it articulates with the lachrymal bone in the lachrymal groove. Below their junction with the nasal bones the nasal processes of the superior maxillæ present a smooth, unattached margin which extends concavely downward to the alveolar process.

FIG. 87.



Framework of the external nose. (Zuckerkindl.) *F*, nasal process of frontal bone; *n*, nasal bone; *s, s*, ascending branch of superior maxillary bone; *t*, triangular cartilage; *a, a'*, lateral limb of alar cartilage; *i*, inner limb of alar cartilage; between *a* and *t*, sesamoid cartilage.

The *pars præmaxillaris* of each upper jaw unite in the centre to form the incisor, also called superior maxillary crest, for the reception of the septal cartilage, the crest ending in front in the inferior nasal spine. The nasal bones, nasal processes of the superior maxillæ, and the *pars incisiva* unite to form the pear-shaped opening of the nasal passages called the *apertura pyriformis*.

The cartilages of the external nose cover the *apertura pyriformis* in the form of a projecting roof. From above downward the cartilaginous portion of the external nose is formed by the anterior projecting border of the cartilaginous septum, the triangular or upper lateral cartilages, the small minor or quadrate cartilages, and the alar or lower lateral cartilages. The upper lateral or triangular

cartilages are two flange-like extensions of the cartilaginous septum. In the centre, in their upper portions, they are continuous with the septum, but below this are divided from it by a fissure. The triangular cartilages pass beneath the edges of the nasal bones and nasal processes of the superior maxillæ for the distance of a few millimetres, articulating with them. Their lower borders are covered by portions of the alar cartilages, so that the margins of the triangular cartilages are covered as seen from without, except at their central junction. The lower borders of the triangular cartilages project into the nose, dividing its vestibule into an upper and a lower portion. The lower lateral or alar cartilages bound the greater portion of the nostrils anteriorly. Each cartilage has

two plates, the outer one of which lies along the outer border of the nostril, while the inner one meets its fellow in the centre and passes backward along the inner border of the nostril. Both plates unite in front at an acute angle; neither extends backward along the entire length of the nostril, but stops about one-half way back, so that the remaining space is filled in with fibrous tissue. Thus the ala of the nose is made up of this and skin only. The minor alar cartilages are small cartilaginous plates behind the alar cartilages, lying as continuations of these in the fibrous tissue.

The muscles of the external nose are the *pyramidalis nasi*, *compressor naris*, *levator labii superioris alæque nasi*, and *depressor alæ nasi*. The *pyramidalis nasi* arises from the lower border of the nasal bone and is inserted into the skin between the brows; it draws the skin downward. The *compressor naris* arises from the nasal bones and cartilages and, passing downward and backward, is inserted into the superior maxillary bone near the *apertura pyriformis*; it wrinkles the nose vertically. The *levator labii superioris alæque nasi* arises from the nasal process of the superior maxilla and, passing downward and outward, is inserted into the wing of the nose and the upper lip; it lifts the wing of the nose. The *depressor alæ nasi* arises from the incisor fossa of the upper jaw and is inserted into the wing of the nose and the septum; it draws the ala of the nose downward and inward.

The facial artery sends the *ramus alaris inferior et superior* to the wings of the nose and a large branch to its dorsum, the *arteria dorsalis nasi*. The nasal artery, a branch of the ophthalmic, leaves the orbit in the region of the inner canthus and anastomoses with the branches of the facial; it supplies the root and sides of the nose. The veins of the nose—*venæ dorsales et laterales nasi*—empty into the angular vein. The lymph-channels connect with the submaxillary lymph-glands.

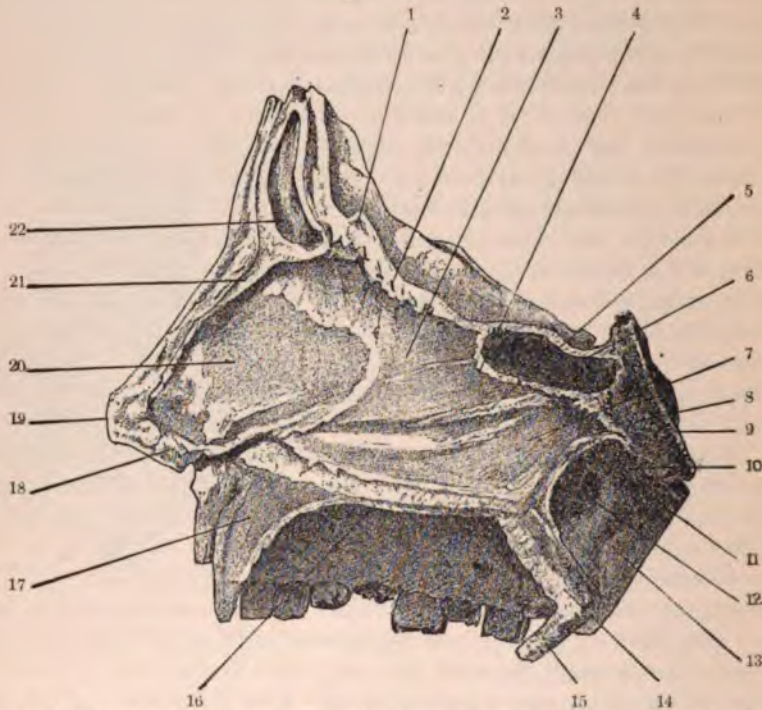
The nasal muscles are supplied by the buccal branches of the facial nerve. The back of the nose receives sensation from the first division of the fifth nerve through the nasal and infratrochlear nerves. The lateral portions of the nose are supplied by the second division of the fifth cranial nerve through the lateral nasal branches of the infraorbital nerve. The vestibule of the nose is that portion of the nasal passages placed in front of the nasal fossæ proper, and is bounded externally by the wings of the nose. The vestibule of the nose extends as high as the *limen nasi*, a prominent ridge caused by the lower border of the superior lateral or triangular cartilage.

The space occupied by the nasal passages in the skull is called the *cavum nasi*, divided by the nasal septum into two passages, the nasal fossæ. These begin in front at the *vestibulum nasi* and extend back to the *choanæ* or posterior nostrils. Above, they reach to the anterior fossa of the skull; below, to the hard palate; laterally, they are bounded by the ethmoid cells and upper jaw. The floor is almost horizontal, the

septum, or dividing wall, vertical, and the roof is concave antero-posteriorly. The nasal part of this extends downward and forward, the ethmoidal portion horizontally, the sphenoidal part descends at first vertically and then extends almost horizontally backward. The jutting angle thus formed is called the promontorium sphenoidale.

The nasal septum is made up of the vomer, the vertical plate of the ethmoid bone, and the cartilage of the septum. The vomer is quadrilateral in form, and its lower border articulates with the nasal crest of

FIG. 88.



View of the nasal septum. $\times \frac{1}{4}$. (Heymann, after Mihalkovics.) 1, crista galli; 2, cribriform lamina; 3, perpendicular lamina; 4, sphenoid; 5, sphenoid process; 6, sphenoid sinus; 7, vomer; 8, sphenoid; 9, clivus; 10, pharyngeal fornix; 11, nasopharynx; 12, Eustachian tube; 13, pharynx; 14, soft palate; 15, uvula; 16, hard palate; 17, maxillary bone; 18, membranous septum nasi; 19, apex nasi; 20, septal cartilage; 21, nasal bone; 22, frontal sinus.

the superior maxillæ and palate bones. The anterior angle fits in behind the incisor crest of the superior maxillæ, and the superior border is attached to the rostrum of the sphenoid bone by two wing-like projections, or alæ. The oblique anterior border joins the vertical plate of the ethmoid bone above, below it is grooved for the passage of the nasopalatine nerve on its way to the anterior palatine canal. The vertical plate of the ethmoid bone (lamina perpendicularis) is pentagonal; its upper border—the longest—joins the cribriform plate, its anterior

short border articulates with the nasal spine of the frontal bone and the median crests of the nasal bones, and the posterior border with the crest of the sphenoid. The lower anterior border is joined to the septal cartilage, while the lower posterior border joins the vomer.

The cartilage of the septum is irregularly quadrilateral. Its shortest lower border extends unattached in the movable part of the septum, and lies above and behind the central plates of the alar cartilages of the external nose. The lower border of the septal cartilage joins the anterior border by a rounded angle. The anterior border is inseparable from the superior lateral cartilages of the external nose, extending to the crest of the nasal bones above. The upper and posterior borders of the cartilaginous septum meet at an acute angle, formed by the vomer and perpendicular plate of the ethmoid bone, to which bones they are attached. The septal cartilage is usually thinnest in the vestibule of the nose and gets thicker back of this. It is formed of two plates, one for each nasal fossa, which are applied to each other for the entire extent of their inner surfaces. The septum is entirely covered by the nasal mucous membrane, the histology of which will be considered in another part of this article. In the region of the anterior palatine canal (*canalis nasopalatinus*) a short epithelial canal is found in the septal mucous membrane. This is called the organ of Jacobson, the entrance to which is not more than one millimetre in diameter. It is a rudimentary representation of an organ of the sense of smell found in some lower animals.

The arterial and nervous supply of the septum nasi is double,—that is, each artery and nerve has its mate on the other side of the septum, due to embryological development. The anterior part of the septum receives branches from the arteries of the external nose and the anterior ethmoidal artery, a branch of the ophthalmic. The posterior part of the septum is supplied by the sphenopalatine artery, a branch of the internal maxillary, which reaches the septum after passing through the sphenopalatine foramen. The artery then passes downward and forward on the septum to the anterior palatine canal.

The veins of the septum empty into the vena sphenopalatina and the ethmoidal veins. They also communicate freely with the veins of the dura by passing through the foramina of the cribriform plate of the ethmoid bone. This is a fact of importance in regard to emboli or thrombi due to disease of the septum. A part of the septum above the *pars incisiva* of the upper jaw, of an area the size of a cent, is supplied with papillæ with large central veins and covered by a thin layer of pavement epithelium. This place is known as the seat of frequent bleedings from the nose, owing to its peculiar vascular supply.

The sensory nerves of the septum come from the first and second divisions of the fifth pair. The anterior part of the septum, as far back as the *pars incisiva* of the upper jaw extends, is supplied by the septal branch of the nasal nerve. The latter, after entering the nose through

the foremost foramen of the cribriform plate, passes under the mucous membrane in a groove under the nasal bones and becomes cutaneous on the back of the nose. The rest of the septum is supplied by the nasopalatine nerve, a branch of the second division of the fifth pair. The nasopalatine nerve enters the nasal cavity through the sphenopalatine foramen, and passing obliquely downward and forward on the septum, passes through the anterior palatine canal (*canalis nasopalatinus*) to the roof of the mouth. It is owing to the course of this nerve on the septum that operations for the removal of spurs or necrotic pieces of bone from the vomer cause pain referred to the upper incisor teeth.

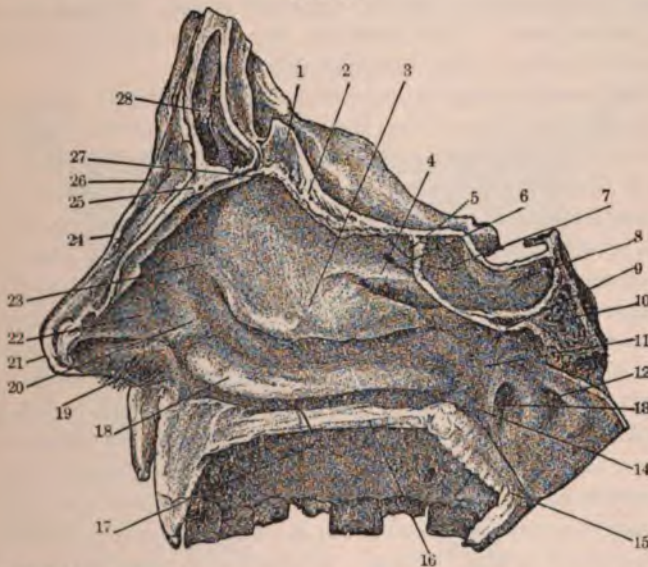
The branches of the olfactory nerve do not reach below the upper third or fourth of the septum, and are spread out in a coarse net-work of branches. These pierce the foramina of the cribriform plate of the ethmoid bone, and are accompanied by a sheath of the *dura mater*.

The roof of the *cavum nasi* presents a nasofrontal, ethmoidal, and sphenoidal portion. The nasofrontal portion is the part lying under the nasal bones. The ethmoidal portion is covered by the cribriform plate of the ethmoid bone, with its two rows of foramina for the passage of the inner and outer bundles of olfactory nerve-fibres. The most anterior of these foramina gives passage to the nasal nerve. The sphenoidal portion of the nasal roof includes the body of the sphenoid bone. The anterior vertical surface of this joins the ethmoid bone at right angles from below and forms a recess called the *recessus sphenothmoidalis*. The openings of the sphenoidal sinuses are to be seen on this anterior vertical surface of the body of the sphenoid bone. They are quite large in the skeleton, but when covered with mucous membrane vary from the size of a pin-head to that of a lentil. As a rule, the opening to the sphenoidal sinuses lies just beneath the cribriform plate of the ethmoid bone, more rarely in the centre below this.

The floor of the nasal cavity is formed by the *pars incisiva* of the superior maxillæ, their palatine process, and the horizontal plate of the palate bone. About one-half to three-quarters of an inch behind the inferior nasal spine the *canalis nasopalatinus*, or anterior palatine foramen, is located. The foramina from the two sides converge and open by a single opening into the mouth behind the incisor teeth. This canal is closed by the soft parts. The lateral wall of the nasal cavities is formed by the ethmoid bone, the inferior turbinated bone, the upper jaw, the vertical plate of the palate bone, and the internal pterygoid plate of the sphenoid bone. The lateral mass of the ethmoid bone contains the ethmoid cells or labyrinth, and extends from the roof of the nose down to the level of the floor of the orbit. Posteriorly the lateral mass articulates with the rough surface on each side of the body of the sphenoid bone. Anteriorly it articulates with the lachrymal bone and the nasal process of the superior maxillary bone, above with the orbital portion of the frontal bone on each side of the ethmoidal notch, the frontal bone

presenting depressions which, when joined to corresponding ones in the ethmoid bone, complete some of the ethmoidal cells and the anterior and posterior ethmoidal canals. Below, the lateral mass of the ethmoid bone articulates with the orbital portion of the upper jaw and orbital process of the palate bone. All these neighboring bones help to close in the ethmoidal cells, some even containing accessory air-cells. On the outer surface the lateral mass of the ethmoid bone is closed by the thin lamina papyracea, or orbital plate, which forms part of the inner wall of the orbit. This is apt to be forced in towards the orbit in disease of the eth-

FIG. 89.



Lateral wall of the nose; sounds lying in the lachrymonasal duct and in the cavity of the sphenoid. $\times \frac{3}{4}$. (Heymann, after Mihalkovics.) 1, crista galli; 2, cribriform lamina; 3, middle turbinate; 4, superior turbinate; 5, spheno-ethmoid recess; 6, superior (turbinate) meatus; 7, opening of sphenoid sinus; 8, sphenoid sinus; 9, sphenoid prominence; 10, sphenoid bone; 11, nasopharyngeal meatus; 12, pharyngeal recess; 13, mouth of Eustachian tube; 14, salpingopalatine fold; 15, soft palate; 16, hard palate; 17, nasolachrymal duct; 18, inferior turbinate; 19, ala nasi; 20, entrance to middle meatus; 21, apex nasi; 22, limen nasi; 23, agger nasi; 24, dorsum nasi; 25, nasal bone; 26, root of the nose; 27, fornix nasi; 28, frontal sinus.

moid cells, causing displacement of the globe. The inner or mesial wall of the lateral mass forms the outer wall of the nasal fossa, and is composed of two shell-like bones, the upper and middle turbinates. These are grooved for the fibres of the olfactory nerve and for blood-vessels.

The inferior turbinated bone divides the middle from the inferior meatus of the nasal fossa. At its upper margin it is attached to the inferior turbinate crest of the superior maxilla in front, behind this by means of the lachrymal process to the lachrymal bone, back of this the maxillary process descends to close the lower part of the opening to the antrum. Posteriorly the inferior turbinated bone articulates with the

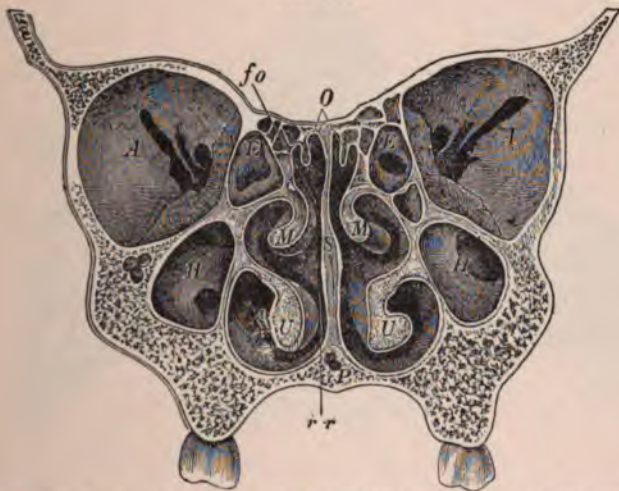
uncinate process of the ethmoid by means of the ethmoidal process. The body of the inferior turbinated bone curls outward and downward over the inferior meatus of the nose. The nasal surface of the body of the superior maxilla forms the greater part of the outer wall of the nasal fossa, but is covered almost entirely by the two lower turbinated bones. In front it presents a crest for articulation with the lower turbinated bone, above and behind this is the large opening to the antrum of Highmore, the closure of which is completed by the inferior turbinated bone, the palate bone, and the uncinate process of the ethmoid. Above this the nasal surface of the body of the upper jaw presents one or two half-cells closed by junction with the ethmoid bone. Behind it articulates with the palate bone. This presents two crests (*cristæ conchales*) for junction with the two lower turbinated bones.

The arteries supplying the mucous membrane of the nose, except the septum (considered above), are the outer branch of the sphenopalatine artery, which anastomoses with the branches of the anterior ethmoidal artery from the ophthalmic and the branches of the facial to the septum.

The veins form a close net-work in the mucous membrane, and over the turbinates produce a species of cavernous plexus, which accounts for the tendency of the mucous surface of the turbinated bodies to swell rapidly. The lymph-channels discharge towards the palate and pharynx and empty into the cervical glands. The lymph-vessels connect by means of the cribriform plate with the subdural and subarachnoid spaces. The anterior part of the mucous surface of the nose is supplied with sensation by the nasal nerve over a region corresponding to its cutaneous distribution from the root of the nose to its tip. The greater part of the mucous membrane of the nose receives sensation from the superior and inferior nasal branches derived from Meckel's ganglion, second division of the fifth pair of cranial nerves. The superior branches are distributed to the mucous membrane over the upper and back part of the septum and over the superior and middle turbinated bodies. The inferior branches are distributed to the inferior turbinated bodies and corresponding part of the lateral wall of the nose. The anterior superior dental nerve gives off a branch in the wall of the antrum, which supplies the mucous membrane of the anterior part of the inferior meatus and floor of the nasal fossa. The lateral portion of the fibres of the olfactory nerve is spread over the upper surface of the middle turbinated body as far down as the lower border of the superior turbinate. The turbinated bodies do not extend along the whole length of the lateral wall of the nasal fossa. The lower reaches farthest forward, the middle nearly as far, while the superior is not visible from in front and extends as far forward as the posterior third of the middle turbinal only. In front of the anterior ends of the turbinated bodies is a smooth triangular surface called the atrium meatus medii. The only point of interest here is the *agger nasi*, a low elevation continuous with the middle turbinate.

The middle turbinated body is much larger than the upper,—from one and one-quarter to one and one-half inches long and five-eighths of an inch high. Its attachment is peculiar in that anteriorly it has the shape of an inverted U, creating a deep recess (*recessus frontalis*, Killian). This recess is not visible until the middle turbinal is removed. Its top reaches up nearly to the floor of the frontal sinus, underneath the middle turbinal. The inferior turbinal is less deep than the middle, but longer,—from one and one-half to two inches. It curves downward usually to within one-eighth of an inch of the nasal floor. The turbinated bodies are often rudimentary in their development, a condition causing abnormally large passages, with a tendency to drying and decomposition of secretions.

FIG. 90.



Transverse section through the posterior portion of the nasal cavity. (Zuckerkindl.) *U*, lower turbinal; *M*, middle turbinal; *O*, superior turbinal; *S*, septum; *P*, hard palate; *H*, antrum of Highmore; *E*, ethmoidal cells; *A*, orbit; *fo*, olfactory region; *rr*, respiratory region.

There are three nasal meatuses. The upper is short, lies under the superior turbinal, and extends forward only as far as the middle of the cribriform plate of the ethmoid bone. It contains the openings of the posterior ethmoidal cells.

The middle meatus consists of a portion underneath the middle turbinated body and a part not covered by this. This latter portion is wider in front than behind, begins at the atrium meatus nasi medii, or vestibule of the middle meatus, in front, and extends back to the anterior fold of the Eustachian opening. The portion of the middle meatus covered by the middle turbinated body is a region of great importance to the rhinologist. It is narrow behind and wider in front, where it forms the recessus meatus medii mentioned above.

The outer wall of the middle meatus presents a semilunar sulcus of

curved shape, with its concavity upward, its anterior end extending into the recessus. This is the infundibulum, also called the hiatus semilunaris. The infundibulum may be shallow or a deep narrow slit. From before backward the frontal sinus, anterior ethmoidal cells, and maxillary sinus empty into it. The opening of the frontal sinus is in the highest upper part, and may be of the size of a lentil. The opening of the antrum lies in the posterior shallow part of the hiatus semilunaris, and is usually surrounded by a fold of mucous membrane. The size of the opening varies, and is from one-quarter to three-eighths of an inch in diameter. The opening in the skeleton is much larger than the opening in the

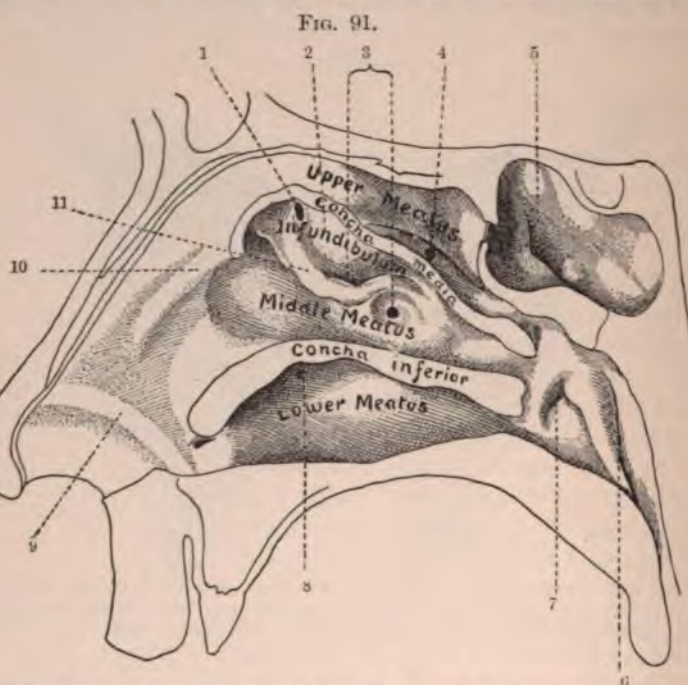
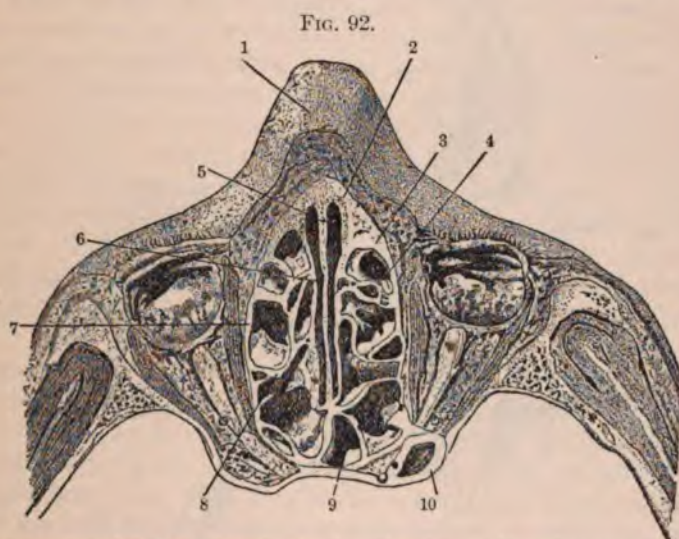


Fig. 91. Lateral wall of the nose; the middle and inferior turbinate are removed. (M. Schmidt, after Merkel.) 1, frontal sinus; 2, ethmoidal bulla; 3, maxillary sinus; 4, ethmoidal cell; 5, sphenoidal sinus; 6, pharyngeal recess; 7, Eustachian tube; 8, nasolachrymal canal; 9, limen nasi; 10, agger nasi; 11, lateral ridge of mucous membrane.

mucous membrane. Just above the hiatus semilunaris there is a prominence due to a large ethmoidal cell. This is called the bulla ethmoidalis.

The inferior meatus has a narrow uncovered portion, which begins in front over the pars incisiva of the upper jaw and is lost behind in the salpingopalatine fold of the Eustachian orifice. A little in front of the centre of the portion covered by the inferior turbinated body is the opening of the lachrymal duct. This opening may lie immediately under the insertion of the lower turbinated body or be found lower down near the centre of the meatus.

The accessory sinuses of the nose are air-chambers surrounding the nasal cavity on all sides. The frontal sinuses are situated in the frontal bone above the root of the nose, and extend laterally to about the region of the supraorbital notch. They are separated by a thin, bony septum that is seldom in the middle between the two sinuses, but usually a little to one side of this. The frontal sinuses vary greatly in extent. They may be rudimentary or absent, and are smaller in women and children than in men. If large, they may extend backward the entire length of the orbit and laterally as far as the zygomatic process. The opening of the frontal sinus is at its lowest portion, and usually opens directly into the upper part of the infundibulum without a canal or duct inter-



Horizontal section of the face through the ethmoid region. $\times \frac{3}{4}$. (Heymann and von Mihal-kovics.) 1, external nose; 2, opening of the nostril; 3, frontal process; 4, anterior ethmoid cells; 5, septum; 6, olfactory fissure; 7, lamina papyracea; 8, posterior ethmoid cells; 9, sphenoid sinus; 10, sphenoid bone.

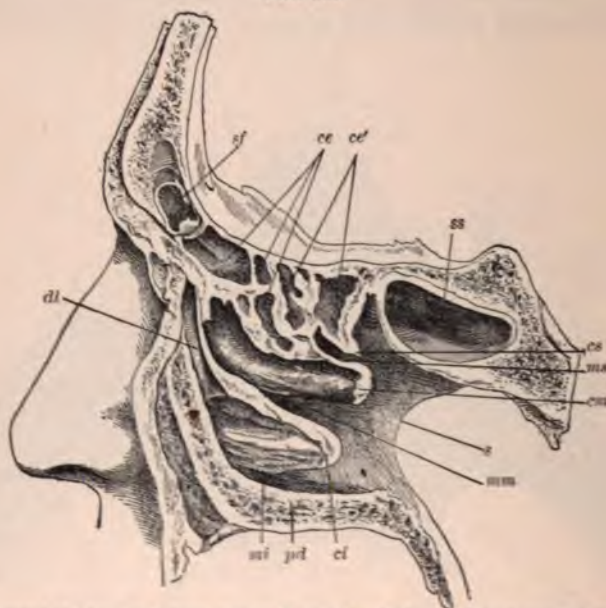
vening, unless one is provided by encroachment of ethmoidal cells. The nerves of the frontal sinus are branches of the nasal nerve.

The ethmoidal cells fill in the space between the orbit and lateral wall of the nasal fossa. They are divided by a transverse septum into an anterior and posterior set of cells. The anterior cells empty into the infundibulum in its middle portion, the posterior into the upper meatus. The ethmoidal cells are separated from one another by thin plates of bone.

The anterior ethmoidal cells are supplied with sensation by the nasal nerve as it passes through the anterior ethmoidal foramen. The posterior ethmoidal cells are supplied by the posterior ethmoidal nerve. The arterial supply is derived from the anterior and posterior ethmoidal arteries, branches of the ophthalmic.

Like the frontal, the sphenoidal sinus varies greatly in size, from a rudimentary state to one in which it sends prolongations into the pterygoid processes and greater and lesser wings of the sphenoid bone. The sphenoidal sinus is divided into two lateral portions by a septum. This septum is seldom central, so that the two divisions of the sinus are of unequal size. They have an irregularly triangular shape, broadest in front. The opening of the sphenoidal sinus is high up under the nasal roof in the recessus sphenoidalis; it is small and poorly located for

FIG. 93.



The outer wall of the nasal fossa removed and the lachrymal duct opened its entire length. (Stoerk.) *pd*, hard palate; *ml*, lower meatus; *cl*, lower turbinate; *mm*, middle meatus; *cm*, middle turbinate; *ms*, superior meatus; *cs*, upper turbinate; *dl*, ductus lachrymalis; *sf*, frontal sinus; *ce*, anterior ethmoidal cells; *ce'*, posterior ethmoidal cells; *s*, septum; *ss*, sphenoidal sinus.

drainage. The nerves of the sphenoidal sinus are derived from the Vidian nerve.

The antrum of Highmore, or maxillary sinus, is the most important of the accessory sinuses. It presents four surfaces,—orbital, facial, nasal, and temporal. The orbital or upper surface is formed by the thin plate of bone which is the floor of the orbit. The facial surface has the thickest and strongest wall. It is heavily buttressed by a ridge leading from the first molar tooth to the zygomatic process, which divides the temporal from the orbital surface. The facial wall is thinnest in the canine fossa, but not very thin here. The temporal surface faces downward and backward. It is formed by a thin plate of bone separated from the great wing of the sphenoid by the inferior orbital or sphenomaxillary fissure. Its

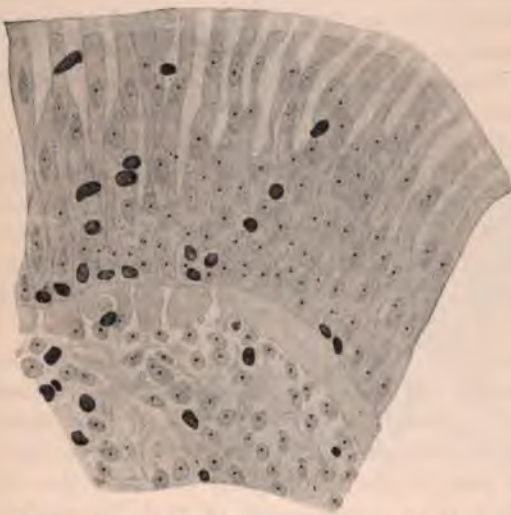
surface is convex and on the same plane as that of the temporal surface of the great wing of the sphenoid bone. The nasal surface is vertical and chiefly situated under the lower turbinated bone in the lower meatus. The antrum has no floor proper, as its surfaces converge towards the bottom, which is formed by a trough or groove above the alveolar process of the roots of the teeth, called the *sulcus alveolaris*. In men this usually is on a level with the floor of the nose, in women on a lower level. The opening of the maxillary sinus, as seen from within, is placed high up under the orbital plate, and connects with the infundibulum by a short oblique duct. This explains the difficulty of probing the natural opening to the sinus and its unfitness to act as a drain in cases of empyema. The posterior superior, the middle superior, and the anterior superior dental nerves are contained in the walls of the antrum. They are separated from its mucous membrane by a layer of thin bone forming the inner wall of the canals in which they are contained as they pass down to the teeth of the upper jaw. This thin plate of bone may atrophy, so that these nerves often run directly underneath the mucous membrane of the antrum, causing severe neuralgias in case of disease of this sinus. The infra-orbital nerve is also very near the mucous surface, so that it can be seen from below. The arteries of the antrum come from the infraorbital artery and the lateral arteries of the nasal cavity. The superior dental nerves just mentioned supply the mucous membrane of the antrum with sensation.

The interior surface of the antrum may present partial septa, causing deep pockets, or complete septa, dividing the space into two or more cavities. In this latter case, in operations for empyema of the antrum, the operator may open a cavity containing air while he fails to reach the one containing pus. The floor of the antrum may be so low that the alveoli of the teeth project into it as prominences, or that the roots of the teeth may be seen covered only by mucous membrane, the bone being deficient. As a result of deficient absorption of the spongy tissue of the upper jaw, the antrum may be very small and have thick walls, so that the surgeon may find it hard to penetrate them. The walls of the antrum may so approximate that it becomes a mere fissure rather than a cavity. Such cases present facial asymmetry with a sunken cheek and enlarged nasal fossa on the affected side. The antrum may be abnormally large and present extensions into the malar bone or hard palate.

The Mucous Membrane of the Nose.—The integument with hairs and sebaceous glands enters the nostrils from the face and extends inward as high as the alar cartilages reach. Where the alar cartilages join the superior lateral cartilages, the so-called *limen nasi*, there is a narrow zone in which the integument presents the characteristics of mucous membrane with pavement epithelium and muciparous glands. This pavement epithelium gradually merges into the typical ciliated epithelium of the lining of the nasal passages, called the respiratory mucous membrane.

The ciliated epithelial lining of the floor and outer wall of the nasal passages reaches forward towards the nostrils about as far as the lower anterior border of the superior lateral cartilage. The anterior portion of the inferior turbinated body may have pavement or ciliated epithelium. On the septum the same conditions exist. First a region with skin with hair-follicles extending upward as far as the alar cartilage reaches, then a zone of mucous membrane with pavement epithelium which reaches back from the dorsum nasi as far as the thin anterior part of the septum extends. Here the pavement epithelium also gradually merges into the ciliated variety. Where the lining membrane of the nose is of the character of

FIG. 94.



Section through normal mucous membrane of the middle turbinal, showing epithelium and connective tissue beneath. (Schiefferdecker.) The long bright spaces between the ciliated cells are the portions of the goblet-cells which are filled with mucus. The light streaks which traverse the basement membrane are the basal canals. The dark enclosed bodies are the nuclei of leucocytes, which can be seen in the epithelium as well as beneath it.

the skin the subepithelial connective tissue is distinct from the perichondrium, to which it is but loosely connected. Above the alar cartilages, however, where the mucous membrane proper begins, the periosteum or perichondrium is firmly united to the submucous connective tissue. Where pavement epithelium merges into ciliated the pavement epithelium extends for a short distance under the ciliated variety. As the ciliated epithelium is approached the pavement cells get rounder, then conical; finally, short ciliated epithelial cells appear with goblet-cells until the typical longciliated epithelium is reached.

Papillæ with loops of blood-vessels extend from the nostrils inward only as far as the respiratory mucous membrane with ciliated epithelium. This variety of epithelium covers all but the cutaneous portions of the nasal lining at the nasal entrance just mentioned and the mucous membrane of the olfactory region. The mucous membrane of the nose is thin in the accessory sinuses, thickest over the turbinals, where it may be from one-eighth to one-quarter of an inch thick. It is inseparable from the periosteum or perichondrium. The posterior ends of the turbinated bodies are apt to present wrinkles and papillary elevations. These are liable to hypertrophy in chronic hypertrophic rhinitis.

PLATE VII.

A section through the mucosa and bone on the inner surface of the lower turbinal. To the left the divided lumina of empty mucous glands are visible; to the right mucous glands with efferent duct. This and the glands are filled with secretion. The epithelium on the surface shows the cilia. In the upper portion of the mucosa the ascending branches of arteries can be seen; in the deeper portions the muscular and connective-tissue walls of the lacunar veins are apparent. The elastic fibres can be observed to take an ascending direction from the periosteum. The adenoid layer is made clear by the large number of nuclei in it. (Heymann.) 1, glandular excretory duct; 2, epithelium; 3, basement membrane; 4, adenoid layer; 5, periosteum, elastic layer; 6, periosteum, cellular layer; 7, bone; 8, bone; 9, glands.

PLATE VII.





The epithelial lining of the respiratory mucous membrane, or mucous membrane proper, of the nasal fossæ is a columnar epithelium of several layers, the topmost layer of which is ciliated. The cells are long and spindle-shaped and interspersed with goblet-cells, which are epithelial cells in a state of mucoid degeneration. The thickness of the epithelial layer is from thirty to seventy micromillimetres. The cilia in the sinuses wave towards the outlets of these cavities. The cilia of the nasal fossæ wave towards the posterior nares. The cilia move in a thin layer of fluid, not in the air. The epithelial layer is thinnest in the sinuses.

Tubular mucous glands are present in great numbers in the mucous membrane of the nose. They are convoluted, branching, or single tubes, and may be superficial or reach clear to the periosteum. Each gland is surrounded by a homogeneous membrane, the *membrana propria*, a continuation of the basement membrane of the ciliated epithelium. The openings of the glands may be at right angles to the surface, or they may reach it obliquely if the gland runs for some distance under the surface. The glands are lined with a single layer of tall columnar epithelium interspersed with goblet-cells. Under the ciliated epithelium of the mucous surface there lies a homogeneous basement membrane. Below this there is a connective-tissue layer of many interlacing fibres continuous with the periosteum. The submucous connective tissue and the epithelium contain varying amounts of leucocytes and lymphoid collections, called adenoid tissue, also lymph-follicles. The submucous tissue and periosteum contain varying amounts of elastic fibres.

The homogeneous basement membrane is perforated by many fine canals which connect the intercellular spaces of the submucous connective tissue with the epithelium. Leucocytes pass through these canals into the epithelial layer, and fluids find their way through them to moisten the surface. These little canals have a diameter of from two to three micromillimetres, and are much narrower than the capillaries. They are very numerous at times, only one or two epithelial cells intervening between two canals. They do not connect directly with the lymph-channels, but only with the spaces between the connective-tissue cells of the submucous tissue. These spaces can be best seen in sections made from hypertrophied mucous membrane. The function of these intercellular spaces and the canals of the basement membrane is probably to supply the great amount of moisture furnished by the surface of the nasal passages and needful to prevent the mucous membrane from drying, and to keep the inspired air sufficiently saturated with watery vapor.

The circulation of the nasal mucous membrane is complex. There are three systems of capillaries,—first, periosteal, then those forming a network around the mucous glands, and finally those supplying the surface of the mucous membrane. The veins are everywhere large in caliber, while the lumen of the arteries is unusually small.

The most remarkable part of the nasal circulation is the so-called

with usually two branches. Their epithelium is very low, and they secrete a serous fluid, while the glands of the respiratory region are muciparous. The glands of the olfactory region are named after Bowman.

There is no basement membrane underneath the epithelium in the olfactory region; the cells lie directly on the connective tissue. In the topmost layers of this are found collections of leucocytes, which lie just under the epithelium, forming a layer of adenoid tissue with occasional lymph-follicles. The blood-vessels of the olfactory region present nothing remarkable. The nerves are for the most part derived from the olfactory nerves; fibres from the fifth pair are also found. The lymphatic system of the nasal mucous membrane connects with the subarachnoid and subdural spaces from which its vessels have been injected.

PHYSIOLOGY OF THE NOSE.

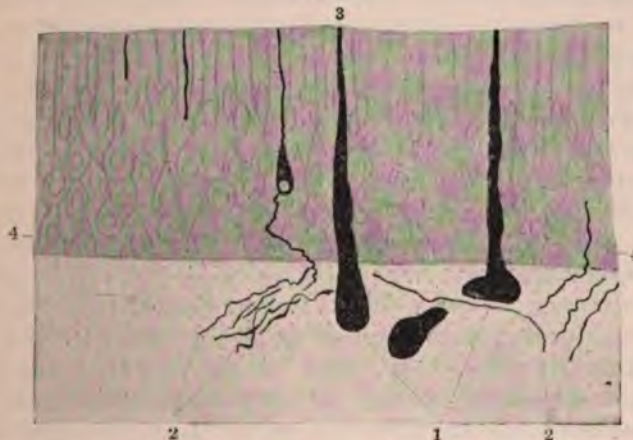
The Respiratory Function.—Paulsen's experiments have shown that the current of air during inspiration at first passes nearly directly upward under the *dorsum nasi*, then follows the roof of the nasal fossæ, the chief part of the current flowing through the middle and upper meatuses and descending behind to the choanæ. In expiration the air takes the same course, with the direction reversed. The act of inspiration creates a negative pressure in the nose, so that at the beginning of inspiration air leaves the posterior nares before it commences to enter the nostril. Expiration causes a positive pressure, so that air enters the posterior nares before any begins to leave the anterior openings of the nose. The air in the accessory sinuses is subject to the same changes of pressure as that in the nasal fossæ, so that in consequence there is a slight current of air leaving and entering them, which becomes increased during strong inspiratory or expiratory efforts. The smallness of the openings to the accessory sinuses prevents any strong current of air from entering them. The changes of atmospheric pressure in the nasal fossæ and antrum of Highmore have been measured with a manometer. In the nasal fossæ they have been found equal to sixty millimetres of mercury during strong inspiration; in the antrum equal to eight millimetres of water. In passing through the nasal fossæ the air becomes saturated with moisture to nearly or quite its full capacity. This has been proved by experiments. The air-current also becomes warmed in passing through the nose, under ordinary conditions, to 86° F. In mouth-breathing there is a sensation of cold in the throat that does not accompany nasal respiration.

Though the nasal passages have but a short course, their mucous surface is of very great extent, while the air passes over it through narrowed and tortuous fissures. The mucous membrane also has a very free vascular supply, as described above, which favors radiation of heat and supplies abundant moisture. All these conditions account for the great amount of warmth and watery vapor supplied to the air-current on its way through the nasal fossæ. For the same reasons the deposit of dust

blood is retained in them, which in cooling warms the respired air. This warming of the air is supposed by some to be the function of the erectile tissue. There is no analogy as to structure between the tissue of the penis and the erectile tissue of the nose.

The olfactory mucous membrane found in the *regio olfactoria*—a region placed by most authors on the upper surface of the middle turbinate and opposite wall of the septum—has a peculiar histological structure. The epithelium is composed of columnar epithelial cells with branching base and a large nucleus. Between these epithelial cells, called supporting cells, are found the nerve-cells of the special sense of smell, or olfactory nerve-cells. The supporting cells are not ciliated, but end above in a flat membrane called the *membrana limitans*, while the olfactory cells terminate in a little bunch of from six to eight hair-like

FIG. 96.



Transverse section through the olfactory mucous membrane of a man of thirty. (Heymann, after von Braun.) 1, Bowman's glands stained with silver; 2, 2, olfactory fibres, one of which is in connection with an olfactory cell (3); 4, basement cells.

processes which project above the surface of the limiting membrane. The olfactory cells are connected directly with a fibre of the olfactory nerve. They have a large nucleus, which gives the cell-body a spindle shape. Underneath the top layer of supporting cells are several layers of epithelial cells, called basal cells, of structure like the supporting cells. It is probable that the olfactory mucous membrane has no ciliated epithelium.

The upper ends of the supporting cells have a yellow pigment, which has given to the olfactory region a yellow color and the name *locus luteus*. The connective-tissue cells of the stroma beneath the epithelial layer in the olfactory region also have a yellow pigmentation.

The mucous glands of the olfactory region differ from those of the respiratory mucous membrane. They are very simple tubular glands,

substances at all,—a condition of partial anosmia analogous to color-blindness. It is a rare condition. In subjective parosmia the individual has a perception of an odor where none really exists. This state is due to disorder of the olfactory nerves or olfactory centre in the brain, and is quite common in the insane. These subjective odors are apt to be of a disgusting character.

Among the nasal reflexes the most familiar is the act of sneezing. The reflex of sneezing is easily excited by irritation of the anterior and posterior ends of the two lower turbinated bodies and the corresponding part of the septum. It seems as if the region of the middle meatus were a location irritation of which by probes and instruments is especially liable to cause sneezing. François Frank has produced spasm of the glottis and of the bronchi by irritation of the nasal mucous membrane. Lazarus also found that the lumen of the bronchi diminished under the same conditions. The impulse here is carried to the muscles of the bronchial walls through the pneumogastric nerve. Irritation of the surface of the nasal cavity may also cause expiratory arrest of respiratory movements. This constitutes a danger in the early stage of chloroform narcosis, especially if associated with spasm of the glottis. The reflexes described above protect the individual from the entrance of foreign bodies into the air-passages. Sneezing expels them from the nose, spasm of the glottis prevents their passing down the windpipe, and narrowing of the bronchial tubes keeps them from entering these. Another type of vasomotor reflexes is that in which irritation of the neighboring cutaneous surface causes contraction of the vessels of the nasal mucous membrane, as cold applications to the neck in nose-bleed. Vicarious menstruation is a type in which the reflex from distant organs causes dilatation of the vessels of the mucous membrane. A great many things have been attributed to nasal reflexes, such as neuralgias, migraine, etc. It is hard to tell whether the relief of these states obtained by nasal treatment is due to suppression of abnormal reflexes or to suggestion. There is a proneness to overestimate the number of morbid states resulting from nasal reflexes, and often—as in asthma, for example—one is disappointed by finding that removal of the nasal disease causes no improvement in the supposed reflex.

ANATOMY OF THE NASOPHARYNX.

The bones to which the nasopharynx is attached are the body of the sphenoid bone, the basilar process of the occipital bone, the petrous portion of the temporal, and the internal pterygoid plate of the sphenoid bone. The basilar fibrocartilage, a thickening of the periosteum, covers the basilar process of the occipital bone and the body of the sphenoid, and, extending outward, fills the petro-occipital fissure and the foramen lacerum, and is lost in the periosteum of the petrous portion.

The basilar fibrocartilage is continuous with the fascia pharyngo-

accounts for the slight hemorrhage occurring during operations for adenoid vegetations. Though the blood flows freely at first, it always ceases in a little while, as no vessels of any size have been severed. Should the inexperienced operator wound the Eustachian tube or lateral pharyngeal wall, the hemorrhage might prove uncontrollable.

The lymph-vessels from the dorsum of the soft palate connect with those of the nose, from its ventral surface with those of the tongue. These lymph-vessels unite to form main trunks that empty into the carotid lymph-glands. The lymph-glands of the upper pharynx empty into glands in the posterior pharyngeal wall and into some glands situated on the great horn of the hyoid bone. The sensory nerves of the nasopharynx are derived from the pharyngeal plexus formed by the vagus, spinal accessory, and glossopharyngeal nerves. The soft palate also receives sensation from the second division of the fifth pair of cranial nerves.

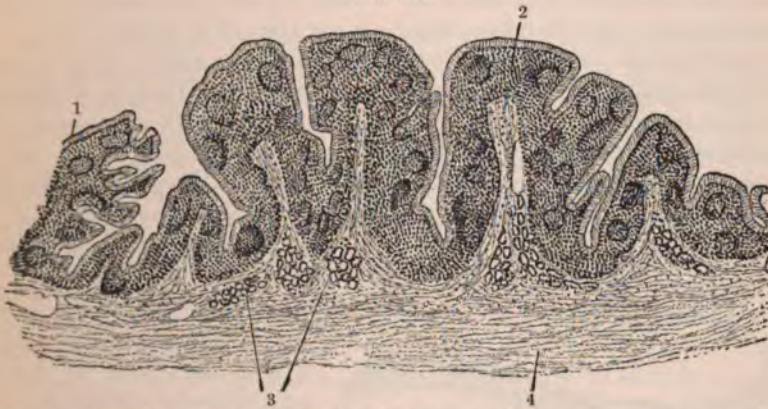
General Description of the Nasopharynx.—The roof or vault of the pharynx reaches from the upper border of the choanæ to the pharyngeal tubercle of the occipital bone. The posterior wall is continuous with the roof, their surfaces being joined by a curved angle. The posterior wall of the pharynx extends from the pharyngeal tubercle down to the lower border of the anterior arch of the atlas. The roof and posterior wall of the nasopharynx contain no muscles, the mucous membrane resting directly on the basilar fibrocartilage as far as this extends, while the posterior wall of the pharynx is separated from the atlas and articulations between this and the occipital bone by loose areolar tissue. The vault of the pharynx contains a structure of great pathological importance, the third or Luschka's tonsil. Up to puberty this is usually normally developed, but in adults it ordinarily disappears by atrophy, or its rudimentary remains alone are present. Luschka's tonsil consists of six or seven longitudinal ridges of lymphoid tissue separated from one another by sulci; the central sulcus is the deepest. Laterally the third tonsil reaches as far as the vault of the pharynx extends, or to the fossa of Rosenmüller; posteriorly it extends to the foramen ovale; anteriorly its margin is the upper border of the choanæ. In pathological cases portions of the third tonsil are found in the posterior nares, arising from the upper and lateral borders of the choanæ, a fact of great importance in regard to the operation for adenoid vegetations, and one which will be considered in its description.

The mucous membrane in the region of the third tonsil is friable, thick, and soft, and has a grayish-red color. Back of the pharyngeal tonsil there is occasionally found a pocket in the mucous membrane extending deeply to the occipital bone. It is called the bursa pharyngea. The junction of the roof and lateral walls of the nasopharynx posterior to the Eustachian tube creates a deep recess called the recessus pharyngeus, or fossa of Rosenmüller. Anterior to the fossa of Rosenmüller the

Eustachian tube can be seen jutting from the lateral pharyngeal wall. The direction of its canal is downward, forward, and inward. It may open in the shape of a funnel or as a narrow triangular slit. The extremity of the Eustachian tube is removed from the posterior end of the inferior turbinal by about one-fourth of an inch. When the soft palate is raised it closes the nasopharynx below and forms its floor. The anterior boundary of the nasopharynx is formed by the posterior nares.

Histology of the Nasopharynx.—Ciliated epithelium in a single or in several layers lines the interior of the nasopharynx and back of the velum palati. On the posterior wall ciliated epithelium extends in children as far down as the level of the soft palate; in adults only down to the level of the upper border of the superior constrictor of the pharynx.

FIG. 98.



Transverse section of the pharyngeal tonsil of a one-year-old child. (Heymann.) 1, epithelium; 2, propria; 3, glands; 4, basilar fibrocartilage.

Below this the ciliated epithelium merges into pavement epithelium. Beneath the epithelium there is a basement membrane and, as far as the ciliated epithelium extends, no papillæ. The pharyngeal mucous membrane contains many elastic fibres and mucous glands which are especially numerous on the pharyngeal vault.

The minute anatomy of Luschka's tonsil requires especial attention. It is simply a thick mucous membrane of the same structure as that found elsewhere in the nose and nasopharynx, with the lymphoid element so pronounced as to overshadow the other elements. There is, therefore, no essential difference between the structure of the third tonsil and that of the rest of the nasal and nasopharyngeal mucous membrane, so that it can readily be understood why adenoid vegetations are often found within the openings of the posterior nares.

CHAPTER II.

THE EXAMINATION OF THE NOSE AND NASOPHARYNX.

EXAMINATION OF THE NOSE.

THE examination of the external nose obviously requires no special methods. The surgeon can estimate the capacity of each nostril for the passage of air by closing its fellow with the finger and listening to the sound made by breathing. Air passing through a clear nasal fossa causes almost no sound, but if there be an obstruction of even moderate degree there is a sound of a stenotic, hissing character. This method is of value, because it is not always possible to see the cause of a nasal obstruction, if far back, for posterior rhinoscopy cannot always be used.

A head-mirror, of the kind used in laryngoscopy, preferably of a diameter of four inches, is necessary for rhinoscopy as ordinarily performed. It is better to concentrate the rays of the light used with a condenser, but not absolutely necessary. The reflector can be replaced by one of the modern miniature electric lights with condensing lens worn on the forehead. The chief advantage of these lights lies in their making the

person performing rhinoscopy independent of a source of light to reflect from, so that the examiner's head can be approached close to the patient's face or withdrawn from it without interfering with the focus, as when the mirror is used, and it also saves the

FIG. 99.



Ingals's nasal speculum (three-fifths natural size).

patient the annoyance of the heat of the gas-flame. Six-volt lights are the most practical, and the cylinder containing the light and its condensing lens should never exceed five-eighths of an inch in diameter. The reason for this is that the rays leaving a wide cylinder form an angle with those returning to the eye from the illuminated object, so that it is impossible to see to any depth, while the axis of a narrow cylinder can be placed so close to the axis of the eye that the angle formed by the projected and returning ray is of no consequence, as the rays are for all practical purposes parallel. Most of the cylinders furnished by mechanics are too wide, their idea being to give a large illuminated field by means of a large lens, while all that is needed is a spot of light one and one-half inches in diameter.

Of all the many styles of nasal specula in use the most satisfactory is the simple bivalve form. The one shown in Fig. 99 has proved most serviceable for examinations and operating.

The first step in rhinoscopy is the inspection of the vestibule of the nose without a speculum, as there are often found eczematous crusting, patches, and fissures in this region which render examination with a speculum inadmissible by reason of its painfulness. Little children fear a speculum, and, as their vibrissæ are undeveloped, it is usually easy to inspect infantile nasal passages without an instrument. The nasal speculum is to be opened gently, as its rough use causes a good deal of pain. The examiner's head should be so placed that his eyes are on a level with the inferior meatus. The foreshortening in the appearance of the parts makes the aspect of the nasal interior rather confusing to those unused to seeing it, as everything is viewed apparently on edge. It is well to follow a systematic course in making a nasal examination, otherwise it is easy to overlook something in inspecting the complicated nasal fossæ.

The object first noticed is usually the inferior turbinated body, which presents as a reddish prominence above the inferior meatus, larger or smaller according to the amount of distention of its erectile tissue. If the inferior turbinated body be small or retracted, the examiner can often look into the nasopharynx, recognizable by the motions of the levator palati in phonation. The middle turbinated body can be seen above the lower, usually pale in color and more translucent than the lower one. It lies close to the septum, separated from it by the narrow olfactory fissure, and is visible for about one-half its length. The superior turbinate and meatus are invisible from in front. The septum usually presents a deflection to one or the other side, and is often marked by prominent ridges or spurs. To determine its thickness a septometer may be used,—a caliper-like instrument. At the level of the anterior end of the middle turbinate and a little in front there is a soft prominence of the mucous membrane of the septum, capable of swelling, as does the inferior turbinate, called the tuberculum septi. It retracts under cocaine, and its irritation easily arouses sneezing. It may swell enough to cause nasal obstruction at times and require cauterization. The nasal floor presents nothing of interest. Where the middle turbinated body is rudimentary it is possible to see the hiatus semilunaris, processus uncinatus, and bulla ethmoidalis. The lachrymal duct is invisible. The various pathological conditions to be seen in the nose will be considered with the diseases that give rise to them. A light and flexible probe is indispensable in rhinoscopy, for with it the examiner can tell whether a swelling be soft or hard, fixed or movable, and whether carious bone or a foreign body be present. It also informs the surgeon whether there are sensitive regions from which morbid reflexes originate, such as spasmodic sneezing or asthma. It is possible, in a certain percentage of cases, to pass a probe into the accessory sinuses, but the only sinus opening directly visible, and that only in a small proportion of cases, is the sphenoidal sinus.

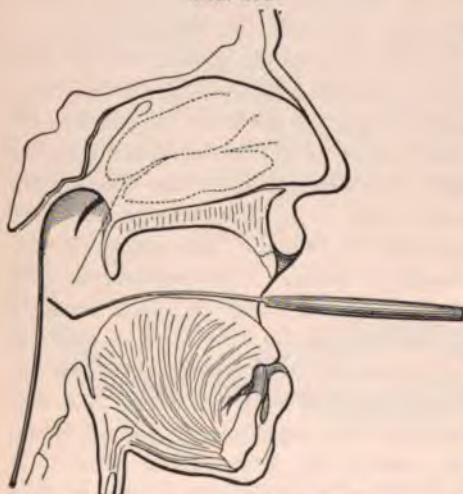
EXAMINATION OF THE NASOPHARYNX.

Posterior Rhinoscopy.—In order to see the nostrils from behind, a mirror must be placed back of the soft palate to reflect light into the nasopharynx. The largest mirror that can be used is the proper one to employ, but usually a No. 1 or No. 2 is as large as one can introduce back of the soft palate, and in children No. 0 or even No. 00 has to be employed. The larger the mirror the more intense the illumination of the visible parts. Many palate hooks and retractors, special mirrors, and other instruments for posterior rhinoscopy have been devised, but most rhinologists prefer simply a tongue-depressor, a laryngeal mirror, and a head-mirror. Palate-retractors are useful in operations, but rather an impediment than otherwise during examinations, as the reflex spasm of

the soft palate they excite elevates it to the pharyngeal vault and makes a view of the posterior nares impossible.

It is well to have two or three mirrors at hand, bent on their wire handles at various angles so that their surfaces can be more readily directed towards the lowest or highest parts of the nasopharynx. The stem of the mirror should have a slight curve, presenting its concavity towards the tongue. The patient should hold his head erect or slightly inclined forward. When the tongue-depressor is introduced he should be told to let his tongue yield to its downward

FIG. 100.



Position for posterior rhinoscopy.

pressure. This is a very effective suggestion, as otherwise he is liable to defeat the surgeon's efforts by pressing the tongue up against the roof of the mouth. For some patients it is better to use no tongue-depressor. The mirror must be warmed and passed back with the reflecting surface upward. The stem should rest nearly on the lower incisor teeth and lie on the back of the tongue, if no tongue-depressor be used. Care must be used in passing the mirror back of the soft palate to touch nothing, so that no reflex spasm of the muscles of the throat will be caused. The posterior pharyngeal wall is the least sensitive of the parts encountered, and in many cases the mirror can be placed against this without exciting retching; it is better, however, to avoid actual contact with it. If the handle of the mirror be depressed the inferior meatus comes into view. As the handle is slowly raised the middle meatus, the upper

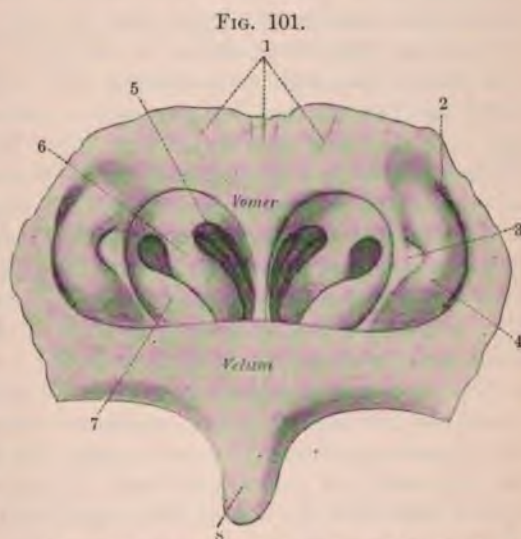
arches of the choanae, and finally the vault of the pharynx are seen. To see all of the latter,* however, a mirror attached to its stem at an obtuse angle is needed. The obstacles to posterior rhinoscopy presented by the tongue can usually be overcome in the way mentioned above. To avoid a long or voluminous uvula one must be satisfied with a mirror so small that it can be placed in the space on either side of the obstacle.

When the fauces and tongue are so irritable that touching them causes retching, this can ordinarily be overcome by spraying them with a five per cent. solution of cocaine. At times, however, the throat is so prone to convulsive action that the taste of the cocaine excites vomiting, and the mere approach of the mirror to the fauces, even without contact, causes spasm. Here nothing but frequent examinations and practice in touching the throat at home will school it to be tolerant of instruments. Nearness of the soft palate to the posterior pharyngeal wall may cause insurmountable difficulties, as here there is no space to reflect light into the nasopharynx. In other cases involuntary contraction of the soft palate will raise it and place it close to the posterior wall of the pharynx. Here the patient is to be told to breathe through his nose and mouth at the same time. Some cannot accomplish this, and for these a cocaine spray will usually deaden the reflex that causes the elevation of the soft palate.

Satisfactory posterior rhinoscopy is more diffi-

cult than laryngoscopy, as, owing to the small mirrors which have to be used, the image is more imperfectly illuminated, the smallness of the field seen at one time makes it harder to recognize, and as only a little of the part to be examined can be seen, the mirror must be moved about so as to get a piecemeal conception of the whole, and this is liable to bring the mirror in contact with irritable parts and cause retching.

The parts first to be sought for are the septum narium and the choanae, as these give the most striking and readily recognizable image. The septum narium bisects vertically the rhinoscopic view, presenting a thin,



Posterior nares. (M. Schmidt.) 1, recess of the pharyngeal tonsil; 2, pharyngeal recess (Rosenmüller's); 3, mouth of the Eustachian tube; 4, posterior lip of the Eustachian tube; 5, superior turbinate; 6, middle turbinate; 7, inferior turbinate; 8, uvula.

clean-cut edge at its lower part, but widening evenly above. Its color is pale pink or yellow in its lower portions, but redder in the upper part, where it has the color of the mucous membrane of the pharyngeal vault, while its sides are grayish pink. From the septum the upper border of the choanae sweeps outward in an arch, curving downward and finally inward, joining the septum again below and forming the two oval openings of the posterior nares. Framed by these from above downward, on the outer wall of the nose are seen the upper, middle, and inferior turbinals.

The *superior* turbinal is usually covered by the large middle turbinal so as to be invisible. It is farther forward in the nose than the middle turbinal, and is a pale red prominence whose borders are not to be seen. The *middle* turbinal is of a light yellowish or grayish red, and the most conspicuous of the three. The *inferior* turbinal appears as a rounded prominence, and is of a light gray or pink color. In many cases it is hard to see, being often hidden by the partly raised soft palate, but when this occurs, thorough cocainization will help to make it visible. Vol-tolini uses two mirrors in these cases in order to see the inferior turbinal and meatus. He introduces one high in the pharyngeal vault and catches its image with a lower one. Of the three meatuses the upper is the largest as seen from behind, the middle decidedly smaller, the lowest almost invisible, as a rule. The Eustachian orifice on each side is found external and posterior to the inferior turbinated body, usually on a level with the middle meatus, but sometimes slightly above or below it. The opening has an irregularly triangular or crescentic shape, and looks downward, inward, and slightly forward. It is bounded by two more or less prominent projections, called the anterior and posterior walls or lips of the Eustachian orifice, which are covered with pale red or yellowish mucous membrane. In some people the lips of the Eustachian orifice are large and jut prominently into the nasopharynx, in others they are almost level with the lateral pharyngeal wall and are hard to see.

The back of the uvula and soft palate can be seen only when the rhinoscopic mirror is held high behind the velum while the latter is completely relaxed; then in the median line the elevation caused by the uvularis muscle can be seen. The posterior pharyngeal wall becomes visible if the handle of the mirror be raised, but it is so much foreshortened that its inspection is unsatisfactory, especially if the prominence caused by the atlas be marked. In the perspective view which is obtained of this part in rhinoscopy the vault of the pharynx appears shorter than natural. The mucous membrane is of a light red color, broken on its surface into irregular, more or less longitudinal fissures and ridges, which give it much the appearance of the surface of the faucial tonsil. This appearance of the surface is due to the adenoid tissue in the mucous membrane of the pharyngeal vault, and is the third or Luschka's tonsil. In adults the rigid surface of the third tonsil disappears and the

surface of the pharyngeal vault is comparatively smooth, as the third tonsil has atrophied. The third tonsil becomes of a pathological size as soon as it causes disturbances, such as interference with nasal respiration or deafness by preventing the ventilation of the middle ear. It will often do this by closing the Eustachian orifice when it is not large enough to obstruct breathing.

Digital examination of the nasopharynx is of great value in diagnosis when the surgeon wishes to determine the consistency of tumors, or when posterior rhinoscopy is unsatisfactory or impossible.

substances at all,—a condition of partial anosmia analogous to color-blindness. It is a rare condition. In subjective parosmia the individual has a perception of an odor where none really exists. This state is due to disorder of the olfactory nerves or olfactory centre in the brain, and is quite common in the insane. These subjective odors are apt to be of a disgusting character.

Among the nasal reflexes the most familiar is the act of sneezing. The reflex of sneezing is easily excited by irritation of the anterior and posterior ends of the two lower turbinated bodies and the corresponding part of the septum. It seems as if the region of the middle meatus were a location irritation of which by probes and instruments is especially liable to cause sneezing. François Frank has produced spasm of the glottis and of the bronchi by irritation of the nasal mucous membrane. Lazarus also found that the lumen of the bronchi diminished under the same conditions. The impulse here is carried to the muscles of the bronchial walls through the pneumogastric nerve. Irritation of the surface of the nasal cavity may also cause expiratory arrest of respiratory movements. This constitutes a danger in the early stage of chloroform narcosis, especially if associated with spasm of the glottis. The reflexes described above protect the individual from the entrance of foreign bodies into the air-passages. Sneezing expels them from the nose, spasm of the glottis prevents their passing down the windpipe, and narrowing of the bronchial tubes keeps them from entering these. Another type of vasomotor reflexes is that in which irritation of the neighboring cutaneous surface causes contraction of the vessels of the nasal mucous membrane, as cold applications to the neck in nose-bleed. Vicarious menstruation is a type in which the reflex from distant organs causes dilatation of the vessels of the mucous membrane. A great many things have been attributed to nasal reflexes, such as neuralgias, migraine, etc. It is hard to tell whether the relief of these states obtained by nasal treatment is due to suppression of abnormal reflexes or to suggestion. There is a proneness to overestimate the number of morbid states resulting from nasal reflexes, and often—as in asthma, for example—one is disappointed by finding that removal of the nasal disease causes no improvement in the supposed reflex.

ANATOMY OF THE NASOPHARYNX.

The bones to which the nasopharynx is attached are the body of the sphenoid bone, the basilar process of the occipital bone, the petrous portion of the temporal, and the internal pterygoid plate of the sphenoid bone. The basilar fibrocartilage, a thickening of the periosteum, covers the basilar process of the occipital bone and the body of the sphenoid, and, extending outward, fills the petro-occipital fissure and the foramen lacerum, and is lost in the periosteum of the petrous portion.

The basilar fibrocartilage is continuous with the fascia pharyngo-

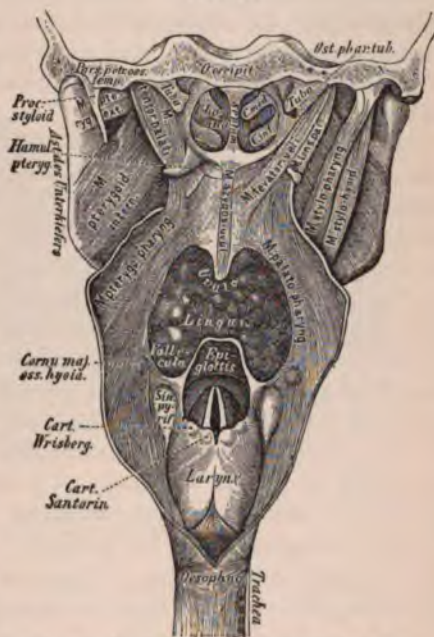
basilaris. This is the fascia of the pharynx proper, and lies under the mucous surface, hanging like a tube from the base of the skull. External to the fascia of the pharynx there is its superior constrictor muscle originating from the border of the choana and the hamulus pterygoideus. The superior constrictor does not extend as high up as the fascia of the pharynx, but reaches to a point below the anterior arch of the atlas. External to the superior constrictor is the stylopharyngeus muscle. The levator palati muscle has its origin from the petrous portion of the temporal bone and the Eustachian tube, to the membranous floor of which it is attached. It passes downward, forward, and inward behind the tube, and is inserted in the shape of a fan into the soft palate. This is the muscle whose motion is visible during phonation if the nasal passages be sufficiently roomy to permit one to see into the pharynx. The levator palati and superior constrictor are supplied by the plexus pharyngeus.

The tensor palati originates along the anterior wall of the Eustachian tube from the great wing of the sphenoid, its origin extending from the spina angularis to the inner pterygoid plate; its tendon passes around the hamulus pterygoideus to be inserted into the aponeurosis of the soft palate and wall of the pharynx. It is supplied by the nervus pterygoideus internus. The musculus uvulæ originates from the aponeurosis of the soft palate, near the posterior nasal spine, and extends as a cylindrical muscle to the uvula. It is supplied by the plexus pharyngeus. The salpingopharyngeus muscle originates from the soft palate and Eustachian tube and passes backward to be inserted into the fascia pharyngobasilaris. It is supplied by the plexus pharyngeus.

The internal carotid artery and the internal jugular vein external and posterior to it are separated from the lateral wall of the nasopharynx by an interval of three-quarters of an inch, and are nowhere in contact with it. The intervening space is filled in with connective tissue.

The blood-supply of the lateral wall of the nasopharynx is exceedingly rich, while the roof contains no blood-vessels of any size. This

FIG. 97.



The muscles of the soft palate, posterior view.
(Bresgen.)

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The basilar fibrocartilage is continuous with the fascia pharyngo-

form by the character of the discharge and the long duration and severity of the symptoms, and inspection will make the diagnosis of membranous rhinitis clear. In early syphilitic rhinitis in infants there is less discharge than in the common variety and a great tendency to formation of crusts. Syphilitic eruptions and the characteristic appearance of the syphilitic infant are aids to diagnosis. Unilateral purulent discharge should lead the surgeon to suspect the presence of foreign bodies or sinus disease.

Prognosis.—The prognosis of acute rhinitis is largely influenced by its cause. Those cases due to virulent infections may lead to suppuration of the sinuses or of the middle ear, and in rare cases to meningitis. In infants the difficulty in breathing, the interference with nursing, and the tendency of the catarrh to invade the larynx and bronchi make the prognosis serious. Chronic suppuration of the tear-sac may remain as a sequela.

In children the lymphatic collection in the nasopharynx called Luschka's tonsil, lying as it does in the course of the lymph-stream from the nose to the pharynx, forms a place for the deposit of infectious elements derived from the inflamed nasal mucous membrane, and it is therefore not remarkable that rhinitis in children is apt to lead to enlargement of Luschka's tonsil. In adults repeated attacks of the disease often result in intumescent or hypertrophic rhinitis. The duration of acute rhinitis is commonly from three days to three weeks, though sometimes it lasts but a few hours, the stage of dryness ending in from two to three hours and that of free discharge in from two to three days. The third period is of very variable duration, and recurrence of the malady after apparent recovery is not uncommon.

Catarrhal otitis media causing in some cases sclerosis of the structures of the middle ear and permanent impairment of hearing may follow acute rhinitis, and the origin of nasal mucous polypi has been traced to repeated attacks of the disease. Acute nasal catarrh in children, with cracks and eczematous surfaces on the nostrils and upper lip and epithelial erosions in the nasal passages, may form a source of entrance for the tubercle bacillus into the lymphatic system. The bacilli rarely lodge in the adenoid tissue of the nasopharynx, but more often infect the cervical lymph-glands, forming in them a source from which in later years infection of the pulmonary apices may take place. Thus the scrofulous state may originate in acute rhinitis in childhood, the chronic nasal catarrh, otorrhœa, eczemas, and hyperplastic lymph-glands following it.

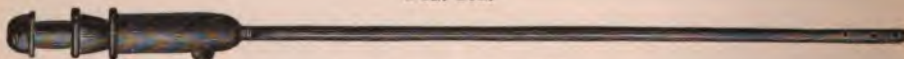
Treatment—Prophylaxis.—The best preventive of acute rhinitis is physical vigor. Out-of-door exercise, proper attention to nutrition and maintenance of the body-weight at its normal standard, cold shower-baths, gymnastics, with avoidance of excessive clothing and overheated houses,—in fact, that careful attention to general health that makes the individual more resistant to depressing influences or infections is the

best means of a general character for the avoidance of attacks of acute rhinitis. Notwithstanding this, most people have their quota of colds in the head, and individual predisposition will make some of the most vigorous frequent sufferers. Local prophylaxis includes the removal of such obstructions as adenoid vegetations, septal deformities, hypertrophic rhinitis, and polypi. It is not usually possible for those exposed habitually by reason of their occupations to the chemical and mechanical causes of acute rhinitis to avoid these, but for those temporarily under their influence it is well to place a light piece of cotton in the nostrils, not enough to stop respiration, but sufficient to catch foreign particles. Where irritating gases are present efficient ventilation is indispensable. Respirators—mechanical contrivances intended to act as dust-filters—are not practicable, as most people cannot be induced to wear them on account of the disfigurement they occasion. Those who use them find decided benefit. Many methods of treatment exist intended to cut short a rhinitis at its beginning,—the so-called abortive treatment. It is obviously as impossible to stop the symptomatic rhinitides at their inception as it is to abort the coryza of measles or scarlatina or influenza. The varieties due to chemical or mechanical agents subside with the removal of the cause. One cannot expect to bring the acute purulent catarrhs due to pus microbes to a speedy end by general abortive measures. This leaves only idiopathic acute rhinitis as suitable for this method of treatment. Considering that acute coryza is doubtless also often due to local infection from the microbes mentioned in a previous part of this article, and that it is of very variable duration, it is difficult to tell how often the speedy termination of a common cold is due to abortive measures. Certainly the vital powers of the patient and his resistance to disease at the time he acquires the cold have much to do with its severity and duration. To check the disease diaphoretics have been in use for a long time. Their effect is to lessen the fluids of the body, and this accounts for their reputation as aborters of the ailment. For diaphoresis Turkish baths are efficient, though they are supposed to lead to increase of the malady if there be incautious exposure following them. Pilocarpine and other diaphoretics have an effect similar to the Turkish bath, and diuretics and cathartics may expedite the cure. These means should be used only when the patient can stay indoors, and it is well for him to limit his fluid-supply in order to prolong the diaphoretic or diuretic beneficial influence. As a course of treatment the following can be recommended: first, a comparatively large dose of quinine or of *nux vomica* and the application to the nares of a one or two per cent. solution of cocaine in water or, better still, in oil, or the insufflation of a powder of three or four per cent. of cocaine. These powders should not be used more than three or four times a day in either naris, and not more than from half a grain to a grain and a half of the mixture should be used each time. The powder which seems most use-

ful contains cocaine three per cent., sodium bicarbonate and sodium biphosphate each one and one-half per cent., iodol twenty-five per cent., light magnesium carbonate one per cent., and sugar of milk enough to make up the whole amount; or this powder may be varied by leaving out the iodol, or by adding one per cent. of alumnol or five or ten per cent. of boric acid. Not more than a hundred grains of any of these mixtures containing cocaine should be given to the patient at once, and he should never be given a prescription that may be repeated. The tendency is to prescribe large quantities of cocaine to give relief in acute rhinitis, when as weak a solution as one grain of cocaine to the ounce of equal parts of a saturated solution of boric acid and water will reduce the obstructing swelling of the nasal mucous membrane enough to give the patient comfortable breathing in an ordinary case of coryza. People differ greatly in their susceptibility to the unpleasant effects of cocaine, palpitation and nervousness occasionally following even moderate doses.

In some cases even better results than from cocaine can be obtained by substituting for it an aqueous extract of the adrenal glands described under chronic rhinitis. In the latter case it is well to use also a spray of oleum petrolatum album three or four times daily. Occasionally

FIG. 102.



Freer's nasal irrigating tube.

patients are seen in whom oily sprays of any kind aggravate the disease, and in such subjects a solution of boric acid is apt to be most soothing. Should the disease run a longer course, the cocaine may be continued in small quantities three or four times a day. The patient may be given with advantage, four or five times daily, small doses of cannabis indica and hyoscyamus, with medium doses of camphor and quinine, or quinine and phenacetin, or quinine and monobromated camphor. The salicylates salol and salipyrin have been recommended as remedies capable of limiting the duration and improving the symptoms of acute rhinitis, and they seem to be of benefit in some cases.

Rhinitis blennorrhoea, or purulent rhinitis, whether occurring in adults or children, requires the removal of the discharge from the nostrils, if possible, by means of irrigations, as sprays are not sufficient in these cases to effect this if the secretions be thick. For adults and children over eight years of age a hard-rubber Eustachian catheter, closed at one end and drilled with three small holes of pin-hole size near the closed end (these holes can be made with a hot needle), is a safe and efficient irrigant; or the catheter, being heated and straightened before use, can be passed back and forth in the nostril into the nasopharynx, while a stream of water flows in tiny jets from the little holes and washes the

nasal cavity with sufficient force to cleanse it of the pus which is often present in dense masses. The supply of fluid is furnished by a fountain syringe that is connected with the catheter by the usual hard-rubber mount. The danger of large streams from the nasal douche or syringe forcing fluid into the middle ear is well known, and is avoided by this instrument, which can safely be trusted to the patient. A good antiseptic wash to use in these cases is potassium permanganate, one-eighth of a grain to the ounce of water.

In purulent rhinitis it is very hard to cleanse the noses of children from two to eight years old, as often even a spray terrifies them and cannot be used. Frequently the surgeon is limited to dropping a few drops of oleum petrolatum album into their nostrils to dissolve dried secretions, and to painting the upper lip and inside of the nostrils with vaseline. This at least protects these parts from the discharge and prevents the formation of crusts. In infants in whom there is extensive secretion, as they can easily be held still, the nose is best cleansed by syringing with a warm alkaline solution. The washing must be performed very carefully, and it must not be forgotten that often even very mild solutions are irritating to the nares and give the child pain. Whenever it is deemed necessary to syringe the nares in a child, it should be placed upon its face and the warm solution introduced slowly, so that it may run out again from the opposite nostril and not be drawn into the larynx. Larger children under eight years will usually not tolerate syringing, and oily sprays with small doses of quinine form the best treatment. For nursing infants whose nostrils are entirely occluded it has been recommended to pass small drainage-tubes through the nostrils into the nasopharynx, so that the children can breathe through these. Feeding with a spoon is necessary when the child cannot nurse. An effective plan for the introduction of oil into the nostrils for the solution of dried secretions is the use of a common oiler, or oil-can of the type used by machinists. It should be filled with thick vaseline oil, which can be dropped into the nares while the patient's head is thrown back. It very effectually takes the place of the more costly atomizer and does not get out of order.

HAY FEVER.

Synonymes.—Hay asthma, rose cold, June cold, autumnal catarrh, rhinitis hyperaesthetica, catarrhus aestivus, coryza vasomotoria.

Hay fever is an acute catarrhal irritation or vasomotor neurosis of the conjunctiva, nasal mucous surface, and rest of the respiratory tract. It occurs periodically, and is characterized generally by profuse discharge, attacks of nasal occlusion due to swelling of the turbinates, and asthmatic attacks. In America the affection usually begins in early August and lasts until the end of September, although a considerable number of cases

are seen in May, June, and July. Men are rather more often affected than women, and the disorder generally occurs before middle age, though it may afflict all ages, even little children. It is a disease of educated people mostly and of city dwellers, while the laboring class is generally spared. Hay fever is but a well-marked type of coryza vasomotoria, or those acute catarrhs of the nose and of the respiratory tract originating in chemical or mechanical irritation of the nasal mucous surface with reflex vasomotor paresis and hypersecretion, so that similar states can be produced by any irritation of the nasal mucous membrane at any time of the year.

Etiology.—Sufferers from hay fever are generally, but by no means always, nervous people, as it will attack very robust individuals with stable nervous systems, while, on the other hand, the majority of even very nervous people do not acquire the disease. It is not known why one individual should respond to irritation of the distribution of the fifth nerve in the nose with a vasomotor relaxation of the nasal erectile tissue and another remain unaffected. Intumescent rhinitis predisposes, yet many with this ailment do not have hay fever. The exciting cause of the attack is commonly the inhalation of the pollen of *Ambrosia artemisiifolia*, known also as Roman wormwood, ragweed, or hogweed, or of *Solidago odora*, known commonly as golden-rod. This is the cause of hay fever proper; but a similar state, known as coryza vasomotoria, of a transient and less obstinate nature, with swelling and free watery secretion, may be caused by dust and smoke, especially in railway travel, by the emanations of roses and other fragrant plants, and by the pollen of certain grasses, as wheat, barley, oats, rye, or even Indian corn. It may also be excited by the dust of ipecac, salicylic acid, benzoic acid, and lycopodium, and sometimes is brought on by exposure to heat or light, or by overfatigue.

J. F. Barnhill thinks that areas made oversensitive by the pressure of septal exostoses or deflections, and polypi or other conditions bringing mucous surfaces in contact in the nasal cavity, are of great moment in predisposing to hay fever. Removal of nasal abnormalities, however, unfortunately, does not usually prevent the occurrence of the disease, though it may mitigate its severity. The so-called uric acid diathesis is one of the alleged predisposing causes of hay fever, but as uric acid has been proved to be a harmless substance, it can hardly create any but a hypothetical diathesis; the state called gout, however, is certainly a predisposing cause.

Pathology.—The anatomical conditions do not differ from those described under acute rhinitis. The catarrhal irritation is not a true inflammatory process, however, as in the infectious varieties of acute rhinitis, but rather an abnormal sensitiveness of the vasomotor reflex are to irritations that ordinarily cause no response. The condition is, therefore, a neurosis characterized by increased activity of the function of

secretion and by acute hyperæmia of the mucous surface with swelling chiefly of the turbinals, which frequently close up one or both nasal fossæ, and show the usual variations of intumescence described with acute rhinitis, at one time leaving the nose almost free for respiration, at others making this quite impossible. The irritation often involves not only the nasal cavity but the larynx, conjunctiva, and bronchial tubes as well.

Symptoms.—So regular is the disease in its annual recurrence that most patients approximately know the date when they will begin to suffer. The disease occurs in two forms, the catarrhal and the asthmatic. In the catarrhal form the irritation is confined to the nares, conjunctiva, and pharynx, while the asthmatic usually follows the catarrhal variety in from two to three weeks, or may exist independently of any nasal symptoms, or if treatment prevent the occurrence of the nasal inflammation. The asthmatic form is therefore usually due to direct irritation of the bronchi rather than to nasal reflex. It is going too far, however, to deny absolutely the existence of nasal reflex asthma.

Hay fever usually begins suddenly in the form of a severe acute rhinitis. Tickling and burning in the nose are felt, while violent sneezing heralds the disease. The mucous membrane swells rapidly, stopping up the nares, while an abundant thin serous discharge occurs. The eyes smart and stream with tears. The conjunctiva is swollen and patients blink in the light. The lids become puffy, and the usual neuralgic pains accompanying rhinitis occur,—aching in the orbit, occipital neuralgia, and pain in the nasal bridge and forehead. The lips and nostrils are raw and excoriated. Affections of the ear are unusual complications, but partial deafness may occur. The sense of smell is generally much impaired or lost.

The attack generally lasts from six weeks to two months, but some fortunate ones recover after a few days. Such persistent suffering for weeks as is entailed by the average attack of hay fever of course tells on the general health, and as true inflammation due to secondary infection succeeds the irritative hyperæmia, fever may occur, but does not belong to the ordinary symptoms of hay fever. Inspection shows nothing differing from the conditions described under acute rhinitis, except that the mucous surface is usually paler, and the discharge watery rather than mucopurulent during the greater part of the disease. Towards the end, however, it becomes opaque through the admixture of leucocytes. Probing discovers areas of extreme sensibility, and these should be noted for future treatment. Though the attack generally ends suddenly, it may gradually fade away.

The asthmatic form of hay fever does not differ materially from ordinary asthma. It presents itself in paroxysms of dyspnoea with dry râles. There is often much annoying cough. The asthmatic attacks happen usually in the daytime, and in this hay asthma differs from the ordinary. There is danger that those afflicted with hay asthma may develop into

confirmed asthmatics with paroxysms at all times of the year. The asthma of hay fever is apt to be prolonged over many weeks, and is of extremely persistent nature.

Diagnosis.—A first attack is hard to tell from a severe coryza, but the history of repeated attacks occurring near the same date, the sensitive areas in the nose, the obstinacy of the disease and the season at which it occurs, together with its general prevalence, make the diagnosis usually easy. In fact, the patient has generally not only diagnosed his case, but has made enough therapeutic attempts to discourage him.

Prognosis.—From thirty to forty per cent. of the patients can be cured by the proper use of the galvano-cautery in the interval; the rest of the hay fever sufferers will at least have the severity of the attack mitigated by treatment; but many, in spite of everything, must expect to suffer more or less, and large numbers look to change of climate as the only relief.

Treatment.—Change of climate will nearly or entirely dispel the symptoms, provided it be to a locality with air free from pollen. In America the favorable localities are Northern Michigan or Wisconsin or the north shore of Lake Huron or Lake Superior. The White Mountains, in some cases high altitudes in the Rocky Mountains, and the sea-shore will give immunity to many. No locality will be found equally beneficial for all individuals, and some will suffer severely where others have complete relief.

The general treatment of hay fever includes all those measures that will diminish the irritability of the nervous system. If impaired, its nutrition must be brought to a proper level by sufficient and judicious eating. The body-weight must, if possible, be brought to its normal state. As a local application to the Schneiderian mucous membrane, a spray of a saturated solution of boric acid will sometimes be found very grateful. In some instances it is well to make this solution in camphor-water; in others it will be necessary to add to it small quantities of atropine, morphine, or cocaine. The latter remedy gives more immediate relief than any other, but, unfortunately, its continued use is frequently followed by most serious consequences. The aqueous extract of the adrenal glands recommended in the treatment of chronic rhinitis has given marvellous relief in some cases. With some patients oily sprays will be found more beneficial. For this purpose a most excellent combination is that of thymol one-third grain, oil of cloves three minims, and oleum petrolatum album one drachm, to which in some cases a small amount (not more than one-half per cent.) of the alkaloid cocaine may be added. The strength of this solution may be slightly increased in some cases with advantage, but care should be taken not to make it irritating. A similar spray used five or six times a day will sometimes prevent the paroxysms of this disease. A powder containing three or four per cent. of cocaine hydrochlorate will be found more convenient for general application. In

whatever way cocaine is employed, the patient should not use more than one-third of a grain daily, and this should not be long continued. Because of the temporary relief afforded, sufferers are very apt to use this remedy to excess, therefore physicians should never give written prescriptions containing it, and should insist upon knowing exactly how much is being used.

Rixe asserts that he has aborted hay asthma with large doses of terpin hydrate, ten grains every three or four hours, two weeks before the attack begins, and during this once in two hours. When the attack of hay fever has developed, but little can be done for it beyond palliation, but in the interval operative measures tend to mitigate or actually prevent the outbreak of the disease. All nasal abnormalities of consequence, as septal spurs, deflections, nasal mucous polypi, hypertrophic or intumescent rhinitis, should be treated as described under their headings. The most beneficial results are obtained by cauterizing the sensitive areas in a superficial manner.

The nasal cavity should first be thoroughly examined with a flat probe, the various parts being gently touched and the sensitive spots marked upon a diagram representing the two surfaces of the nares. A solution of cocaine is then applied by means of a small pledget of absorbent cotton wound on the end of a flat nasal applicator. The pledget saturated with the solution is carried back to the posterior part of the naris, and as it is brought forward is rubbed gently over every part of the mucous membrane to be anæsthetized. This occupies about thirty seconds. A minute later the application is repeated with a fresh pledget. From two to four such applications are generally sufficient. The cauterization may commonly be performed without pain as soon as the patient ceases to feel the probe rubbed lightly over the surface, even though pressure may still be felt.

Before cauterizing the nasal fossæ are to be sprayed with fluid petrolatum, as the oily lubricant makes the manipulation of the electrode in the nose easier. A flat electrode is to be used, preferably guarded in narrow nasal passages. This is heated to a red, not white, heat, and rubbed over a spot in the sensitive area from three-eighths to five-eighths of an inch in diameter until this appears seared and white. The object is not to burn beneath the epithelial layer, simply to blister. The next cauterization should follow in a week or ten days, preferably in the other nostril, and cauterization continued until the probe detects no more sensitive spots. After the cauterization the patient may be given a four per cent. powder of cocaine, which may be insufflated into the nares once in from three to five hours for the following three or four days. Together with this it is well to give an oily spray similar to that already recommended. From fifteen to thirty treatments are generally necessary to cover all of the diseased surface. The following year a few spots may be found still sensitive which were overlooked previously or not burned

deeply enough ; or possibly these may result from a new development of the disease. The above treatment is inadmissible during the attack, as it would add to its violence. It is best instituted in the warm season, a month or two before the expected onset. By this method from thirty to forty per cent. of cases of hay fever may be cured, about twenty-five per cent. may be greatly benefited, and the remainder will usually obtain sufficient relief from the nasal symptoms to compensate for the discomfort experienced during the treatment. The asthmatic attacks are to be treated as are those of ordinary asthma, but to avoid the possibility of the patient's becoming a confirmed asthmatic it is well that he should seek a climate where he will not suffer from hay fever before the usual time of its development.

CHAPTER IV.

EPISTAXIS AND NASAL AFFECTIONS IN ACUTE INFECTIOUS DISEASES.

EPISTAXIS.

Synonymes.—Nose-bleed, hemorrhæa narium.

IN epistaxis there occurs bleeding from the anterior or posterior nares, the hemorrhage originating in the nasal cavity or accessory sinuses.

Etiology.—Predisposition to epistaxis is caused by changes in the composition of the blood, as in anæmia, leukæmia, and scurvy; also acute infectious diseases predispose to nose-bleed and may be ushered in by it. Changes in the vessel-walls, as in arteriosclerosis, and probably also in purpura and hæmophilia, lead to epistaxis. Active hyperæmia of the nasal blood-vessels during violent exertion, and that due to exposure of the head to the hot sun, will increase liability to nose-bleed. Epistaxis is also a symptom of chronic Bright's disease, together with the usual retinal, cerebral, and other hemorrhages. Vicarious nose-bleed may take the place of the menses, or represent them in pregnancy and (rarely) in the menopause.

Passive hyperæmia due to valvular heart disease, liver disease, heavy lifting, straining, or coughing is not an uncommon cause, as also is obstruction of the circulation in the lungs due to emphysema. Diminished atmospheric pressure—as, for instance, that due to high altitudes—will cause nose-bleed. The fatty degeneration of the vessel-walls due to acute or chronic phosphorus- and belladonna-poisoning, iodism, potassium chlorate and iodoform-poisoning, and snake-bites are among the toxic causes of nose-bleed.

Local Causes.—Rhinitis atrophicans will cause epistaxis when scabs are forcibly separated from their base, and foreign bodies, if sharp enough to wound the mucous membrane, produce bleeding from the nose. Fracture of the base of the skull is apt to be associated with nasal hemorrhage, together with bleeding from the ears and subconjunctival ecchymosis. Contusion of the nose is a well-known cause. Bleeding during intranasal operations is usually free and annoying to the operator, on account of its rapidly obscuring the field of vision. A source of serious hemorrhage is found at times in deep syphilitic ulcers, if an artery be opened by them. Some forms of nasal tumors, especially the malignant ones or fibrous polypi, may be the source of profuse spontaneous rhinohemorrhæa.

Pathology.—As epistaxis is only a symptom of many diseases, local and general, the pathological findings will belong to these. There is one condition, however, that is so often found that it may be said to be peculiar to epistaxis,—viz., a small bleeding-point, erosion, or little ulcer found on the anterior part of the septum, where it can easily be reached by the finger-nail, injury of the mucous surface by the finger-nail being often the cause of this condition. The hemorrhage may take place from unusually thin-walled, dilated vessels. Infection of these erosions with pathogenic germs may cause these little ulcers to penetrate to the perichondrium, causing perichondritis, with local death of the cartilage and perforations of the cartilaginous septum often as large as three-quarters of an inch in diameter. These do not close, but leave permanent defects after their borders have healed.

Symptoms.—In plethoric individuals, or where there is vicarious nose-bleed, a feeling of fulness in the head with a sense of intranasal distention, dizziness, and tinnitus may precede the epistaxis, while these symptoms may be relieved by its occurrence, the amount of blood varying from a few drops to a quart or more. It may drop from the nose or run in a little stream, or if epistaxis occur while the patient is lying on his back, the blood may flow backward into the pharynx and larynx and be coughed up. The blood generally flows from one nostril, but if this be blocked, it may pass around behind the septum and flow from the other one. A large quantity of blood may be lost within a few hours, and the bleeding may continue for several days. When the bleeding is excessive, syncope is liable to occur, and may prove fatal. When epistaxis occurs frequently or continues for several days, serious anæmia may result.

Examination of the nose in ordinary cases, when the bleeding has ceased, will usually show the erosion, or bleeding-point, if aided by friction with a swab of cotton on the septum. In some cases, however, in which the surgeon is consulted concerning habitual nose-bleed, he is unable to detect any place which might be a likely source of the bleeding. During the bleeding, wiping away the blood with tampons, if it do not flow too freely, will disclose its source, but often the blood fills the nostrils too rapidly to make an accurate inspection possible.

Diagnosis.—In order to distinguish simple epistaxis from bleeding neoplasms or ulcers, careful inspection is needed. Blood flowing from the nostrils may have its source in hæmatemesis or hæmoptysis. On the other hand, in patients lying on the back, nose-bleed may exist as a concealed hemorrhage, especially if they be in a stupor, the blood being swallowed and later vomited. The blood in these cases may be passed from the bowels as a tarry stool. In other cases the blood is coughed up, making diagnosis from hæmoptysis difficult. The usual source of the bleeding as mentioned is from the thin-walled, dilated vessels of the anterior part of the septum. Blood may, however, flow from any other

part of the nasal cavity, and the inferior turbinal is, next to the septum, its most likely source.

Prognosis.—Ordinary nose-bleed seldom lasts beyond fifteen minutes, though in children it may be of long duration, but is rarely dangerous. Those forms of epistaxis accompanying degeneration of the vessel-walls in old people, or in chronic nephritis, not only indicate a liability to rupture of more important vessels,—as, for instance, those of the brain or retina,—but the hemorrhage itself may be fatal.

Operations on subjects with degenerated arteries are liable to be followed by secondary hemorrhage, which may be profuse even after so slight an operation as the removal of a mucous polypus from the nose.

Nasal hemorrhages frequently recurring and lasting several days at a time, unless properly treated, cause dangerous anæmia, and many, therefore, terminate fatally. In low forms of fever and in diphtheria epistaxis is a grave symptom. On the other hand, in malarial fever, in plethora, or in congestive conditions of the brain the bleeding is sometimes beneficial.

Treatment.—Ordinary attacks of nose-bleed need no treatment, as they soon cease spontaneously. They can be cut short by cold applications to the external nose and nape of the neck or by applications of hot water. The position assumed by the patient is usually a faulty one, as he bends forward over some vessel to catch the blood. This produces venous congestion of the head and adds to the flow. The patient should sit erect, or with his head thrown backward, while by taking deep inspirations through the nose he withdraws the blood from the veins into the capillaries of the lungs. This measure alone will often suffice to stop nose-bleed. As in most instances the blood flows from a small point on the cartilaginous septum, it is easy to check it by continuous compression of the *alæ nasi* for ten or fifteen minutes or by direct pressure of the finger upon the septum. Compression of the facial artery is also recommended. Should the bleeding continue unduly and not yield to simple means, local treatment is needed.

Those at all familiar with rhinoscopy and the use of instruments in the nose will prefer to control the hemorrhage at once by applying tampons rather than to resort to irritating and uncertain styptic powders and sprays, which are liable not to reach the bleeding surface at all in a nasal fossa obstructed with clots and constantly filling with blood. Powdered alum and tannin have been applied, but the former is the source of great pain when in contact with the mucous membrane, while the latter is somewhat less irritating. A spray of tannin, ten grains to the ounce of water, is the most useful of these means, but small pieces of ice dropped into the nares may stop the bleeding. A spray of adrenals is the most effective local application. If the hemorrhage be arrested by these local applications, there is no surety that it will not return when the surgeon is far away and unable to be of assistance, while

a properly applied tampon is an insurance against return of the bleeding, at least until its removal. The best material for tampons is absorbent lint cut into strips one-half an inch wide and from one to three feet in length, according to the amount of space to be filled. The strips are to be thoroughly impregnated with iodol or bismuth subnitrate, which will keep them aseptic for days. Absorbent cotton is a far inferior material, as pieces of it are apt to get lost in the nasal cavity. It has not the virtue of swelling which the lint has, and which in a short time doubles the volume of this material, thus exerting pressure, while, being in strips, none of the lint can get lost in the nose, and it can be withdrawn in one piece. The cotton not only does not swell, but loses elasticity and bulk. Previous to plugging a four per cent. solution of cocaine is to be applied with a swab to the parts against which the lint will impinge. A spray will not penetrate the blood, but a swab will succeed in rubbing a certain amount of cocaine into the mucous surface, this drug having the desirable effect of limiting and sometimes checking the hemorrhage, making the nasal fossa more roomy and the operation less painful. Instead of bismuth or iodol, iodoform and boric acid can be used to impregnate the lint.

The simplest mode of tamponing is that used for the common form of epistaxis, in which the blood flows from the anterior part of the septum. Here it is merely necessary to plug the nasal fossa as far back as the middle of the lower turbinal. In other cases, in which the bleeding comes from the posterior parts of the nasal cavity, the whole nasal fossa must be filled with lint. To introduce this into the nose, the end of the strip is to be seized with the blades of the nasal scissors, or with a pair of nasal dressing forceps with small blades which are not serrated, but smooth on their inner surface. If serrated, the blades pull out the lint again as soon as they are withdrawn. The lint is to be introduced a little fold at a time, so that it can be applied evenly. If too much be seized at once it will form a bunch that will lodge in the nasal passages and obstruct the way back. After the first folds have found a lodgement the rest of the strip enters easily. To pack the anterior part of the nose, the end of the strip must be passed up between the middle turbinal and septum, while the following folds must fill the nasal fossa from above down. If it be desired to pack the whole naris, the end of the lint strip must be passed back to the end of the lower turbinal, but not into the nasopharynx, as in this situation it will create a constant desire to hawk. When the nasal passages are very roomy and the plug shows a tendency to slip back into the nasopharynx, it is well to attach three or four strong threads about two inches apart to the end first introduced. This end is then passed through the naris into the nasopharynx, the free ends of the thread being left hanging from the nostril. The strip is then rapidly pushed in until the posterior part of the cavity is full, after which the threads are drawn upon so as to pack the gauze firmly into the posterior

naris. The whole cavity is then filled with the strip of gauze, any remaining portion being cut off. This method is sufficient to stop the hemorrhage, even in the most severe cases, and will enable one with even moderate skill to spare his patient the dangers and torture of plugging the posterior nares. For a strong styptic effect the strip can be soaked with a syrupy mixture of tannic acid and water to which a little carbolic acid and glycerin have been added. This application causes irritation and smarting, and can ordinarily be dispensed with, as the bismuth or iodol usually suffices as a styptic. Though plugging of the posterior nares has long been practised for checking obstinate epistaxis, it may be regarded as a relic of the past, and will hardly be employed by a rhinologist. It is commonly performed with the aid of Bellocq's canula, by drawing through the nose, from the throat, a strong string, to which is attached a plug of cotton or lint of sufficient size to fill the posterior nares.

Ability to prevent recurrence of epistaxis will depend on the power to remove the cause. The erosions on the septum often bleed, merely because thin scabs which cover them are torn away by the finger or blast of air in blowing the nose. These raw places will heal if the secretions be kept from drying and scabbing by means of ointments like one of equal parts of lanolin and vaseline with two per cent. of salicylic acid. Even if the erosion become a small ulcer, it will often heal under this mild protecting application, which dissolves the scabs beneath which the pent-up secretions cause the ulcer to spread. If the erosion be slow in healing, it can be stimulated by touching it with silver nitrate, sixty grains to the ounce of distilled water. If the source of the bleeding be from small dilated vessels, it is best to sear these with the galvano-cautery heated to a light red. This may succeed in preventing recurrence of the nose-bleed after the first treatment, or perhaps will need to be repeated once or twice. It is, without question, the best treatment for this condition.

NASAL AFFECTIONS IN ACUTE INFECTIOUS DISEASES.

The nasal cavity is the seat of pathological changes in many acute general affections, the chief of which are measles, scarlatina, typhoid fever, influenza, and small-pox.

Measles.—In measles acute catarrhal rhinitis is an almost invariable and prominent symptom, and precedes and accompanies the exanthema. It may be of a severe grade, but does not differ ordinarily from simple acute rhinitis. Illumination by sunlight will show the maculæ in the earlier stages on the septum and turbinals. After the second day the maculæ disappear in the intense general redness, which may be accompanied by a good deal of swelling of the turbinals and sides of the septum. The rhinitis usually disappears with the exanthema, but in rare cases may lead to chronic and atrophic rhinitis. In those cases in which

the rhinitis is of a purulent nature on account of secondary infection it may provoke suppuration of the middle ear, at times of a grave character. Diphtheria is a rare complication. Nose-bleed of a moderate type occurs quite frequently, and is not serious, but in black or hemorrhagic measles nose-bleed is uncontrollable and a fatal complication. As the antrum of Highmore is developed early, it may become involved in the purulent forms of rhinitis in measles in children only one or two years old. Later in life measles may leave disease of the other accessory sinuses.

Scarlatina.—In scarlatina the nose is seldom symptomatically affected, but when it is, the affection is apt to be of a severer grade than in measles. The acute rhinitis of scarlatina may be a slight affection, disappearing with the exanthema. In the severer forms of scarlatina the phlegmonous inflammation of the pharynx may extend up into the nose, which is thus usually invaded through the posterior nares. In these intense grades of scarlatinal rhinitis the discharge is purulent and often offensive and bloody. If scanty, it is apt to form crusts, and the upper lip and borders of the nostrils become irritated, infected, and inflamed by the discharge, so that they appear swollen and red. On account of the great swelling of the nasal mucous membrane nasal respiration becomes impossible. The obstruction to breathing through the nose may also be due to acute inflammation of Luschka's tonsil, which swells and fills the nasopharynx. This and the purulent rhinitis often lead to suppurative otitis media, which occurs far more often than with measles, and is sometimes of great severity, so that the labyrinth may be destroyed and total and permanent deafness result in twenty-four hours.

False membranes occasionally form on the nasal mucous surface in scarlatina, and though usually due to streptococcus or staphylococcus infection, they also quite often contain diphtheria bacilli of a virulent nature, presenting thus a mixed infection. Acute inflammation of the accessory sinuses may occur, and terminate in chronic empyema of one or more of these cavities. In the gravest forms of scarlatinal inflammation of the nasal mucous surface portions of this may become gangrenous, and even caries of the bones has resulted. Chronic rhinitis, both hypertrophic and atrophic, may follow scarlet fever, and many cases of ozæna date from an attack of it.

Typhoid Fever.—Acute coryza is so seldom a symptom of typhoid fever that its presence is almost diagnostic of the absence of that disease. The local changes in the nose that occur in typhoid fever are not so much catarrhal as due to the drying of the nasal secretions and those of the nasopharynx, a condition which is a part of the dryness of the integument and mucous surfaces characteristic of the disease. This predisposes to the adhesion of the nasal mucus to the walls of the nasal fossæ in the form of crusts, which are especially prone to coat the anterior part of the septum and nasal vestibule. These scabs cause nasal

obstruction, and if removed with the finger are apt to produce nose-bleed, which is a prominent symptom of the first week of typhoid fever, but may occur at any time during its course. It almost invariably comes from the place mentioned in the section on epistaxis,—viz., on the anterior part of the septum,—and though usually inconsiderable, has in some cases been severe enough to cause death from exhaustion. The low state of vitality of the tissues in typhoid fever and the tendency in the somnolency of the disease to pick at the nose may lead to abscesses, erosions, ulcerations, or perforations of the septum. Slight injuries may cause quite extensive lesions, while in health they might do no appreciable damage. These morbid states generally run their course underneath crusts, and are hidden by them.

Influenza.—In the acute rhinitis of influenza the bacillus of this disease can usually be easily found by the ordinary methods. In many cases of influenza the nose is not involved at all. The coryza of influenza does not differ from the simple variety except in its obstinacy and severity. Secondary infections with streptococci or staphylococci are frequent, and the disease usually terminates in a long stage of mucopurulent catarrh. Epistaxis is a common accompaniment, and may be severe. Subjective perception of foul odors and other parosmias are frequent enough to be characteristic and show involvement of the olfactory mucosa. Though empyema of the accessory sinuses seldom follows influenza, this disease occurs in such wide-spread epidemics that sinus disease due to it is comparatively common. An eruption in the nares, with obstruction of the passages and subsequently epistaxis, is sometimes caused by small-pox, and cases are not very uncommon in which the nostrils have become occluded by healing of the ulcerated surfaces.

The treatment of symptomatic coryza is that outlined in the description of simple acute rhinitis. The swelling of the nasal mucosa and occlusion of the nose in measles may be very distressing. In older children a spray of cocaine, one grain to the ounce of water, may be allowed, and will add greatly to the patient's comfort. In younger children a soft brush wet with the solution may be passed into each nostril at intervals of an hour or two. The brush may readily be passed along the inferior meatus into the nasopharynx, as suggested by Catti, who employs it to apply a 1 to 5000 solution of corrosive sublimate when the rhinitis is of great severity. He uses the same solution in the purulent or diphtheritic forms of scarlatinal coryza. A spray of adrenals will tend to keep down the swelling of the nasal passages.

When typhoid patients suffer from dryness or stuffiness of the nose, this should always be inspected for crusts. These are to be softened with a spray of oleum petrolatum album, followed by a mild alkaline spray of sodium bicarbonate, a teaspoonful to a pint of water. Irrigation of the nose is rarely needed, as free use of the spray will keep the nares clean and prevent ulcerations and perforations forming under the scabs. In-

and luxuriant granulations may so bury the foreign body that it can with difficulty be seen, if seen at all. The smallness of their openings makes penetration of the accessory sinuses through their natural orifices by foreign bodies in the nose an impossibility. The antrum of Highmore may be the seat of foreign bodies, and reports of these are not rare, but they effect their entrance through the walls of the cavity or penetrate through openings in the alveolar process. Thus bullets may enter the antrum, or fragments of metal, as the result of explosions. The ends of knife-blades have broken off and remained in the sinus maxillaris. Through the alveolar process a foreign body may pierce the socket of a tooth. Portions of roots of teeth may be forced in during extraction, or the extraction may leave an opening into the antrum, which may give passage to various substances. The antrum is quite tolerant of non-septic and non-irritating substances, but if septic germs enter with the foreign body, suppuration of the sinus is to be expected.

Diagnosis.—Unilateral purulent discharge in children up to the seventh year almost invariably means a foreign body in the nostril. In adults necrosed bone can be diagnosed by the defects it leaves, and which are generally in the septum. After second dentition suppuration from the sinuses, especially the antrum, may have to be considered; but though here there is unilateral suppuration, the probe fails to find a foreign body.

The application of cocaine aids greatly in making the diagnosis by reducing the swelling and sensitiveness, so that deliberate examination of the foreign body becomes possible. All pus must be washed away before inspection of the naris is of any use. In little children it is usually easy to see into the nares without a nasal speculum, as their nostrils contain no vibrissæ; and as this instrument or any other is apt to cause them great terror, more can be learned without a nose-speculum than with it in their cases. In the majority of instances, especially recent ones, it is not hard to determine the seat of a foreign body in the nares; but, as an illustration of the difficulty which sometimes attends the diagnosis, an instance may be mentioned in which a long match had been inserted into the nose and been sought unsuccessfully by a physician. The mucous membrane was so swollen and the naris so filled with secretion that the object was found only after carefully wiping this away and feeling backward with the probe along the floor of the nasal fossa.

Foreign bodies in the accessory sinuses can be diagnosed by means of the Röntgen rays, and those lying in the nasal fossæ can also be photographed in this manner, as has been proved by Scheier.

Prognosis.—Small bodies, by the accretion of chalky deposits, may become the nuclei of rhinoliths. They are, as a rule, not dangerous, but in most instances, sooner or later, they provoke an extremely offensive discharge.

Treatment.—Foreign bodies which have recently lodged, and are of the proper shape, can often be expelled by blowing air into the unobstructed nostril by Politzer's method. The attempt to accomplish the purpose in like manner with water is inadmissible, as this would be very apt to enter the middle ear and cause otitis media. Before attempting instrumental removal the nasal fossa should be anæsthetized with cocaine. The best of these for the removal of foreign substances is the steel-wire snare. In one instance a wild tooth was extracted from the floor of the naris in this way. It had caused a catarrhal discharge for several years.

Foreign bodies near the front of the nostril can often easily be removed by passing a bent probe behind them and raking them forward. A small spoon on a flexible shank, like an ear-spoon, can also be used. It may be necessary to employ nasal forceps when large foreign bodies are so wedged that neither wire snare nor instrument can pass behind them. If hard and smooth, the offending material is liable to be pushed back and out of the choanæ into the nasopharynx, whence it may drop into the larynx and cause suffocation. When there is danger of a strange substance following this course it is well to have the index-finger in the postnasal space to control its movements, as advised by Moritz Schmidt. It may be necessary to anæsthetize very unruly children. Foreign bodies which have swollen until tightly held, or have so wedged themselves across the naris that they cannot be extracted without violence, may need reduction in size before removal. This can be accomplished by nasal cutting forceps or by the trephine. As soon as the offending substance is removed the pathological changes it has excited speedily subside in almost all cases. This is true even of those neglected cases in which the foreign body has been lodged in the nose for years.

Rhinoliths.—Rhinoliths are cretaceous masses of comparatively rare occurrence, which usually owe their origin to the lodgement in the naris of some foreign substance upon which calcium phosphate, calcium carbonate, and other mineral substances are gradually deposited from the secretions.

It is supposed that blood-clots may at times give rise to rhinoliths. It is very improbable that they are ever of spontaneous formation. Rhinoliths are apt to be much more formidable as regards symptoms and difficulty of removal than simple foreign bodies. This is due to their tendency to grow to a large size and to their frequently rough surface. They may occupy both lower and middle meatus or perforate the septum narium. Their shape is usually irregularly ovoid, but some have sharp corners, others merely a rough surface, while some are smooth, and many adapt themselves to the shape of the turbinals, of which they form, in a measure, casts. Their color is generally grayish brown or yellowish, greenish, grayish white, dark brown, or dark green, and they are often brittle and friable. They may reach a comparatively large size, weighing from one-quarter to one-half ounce, and may exist in the nose for a long time before removal.

The symptoms are the same as those caused by foreign bodies of simple nature, only generally intensified. Thus, epistaxis is apt to accompany the foul discharge occasioned, and headache and neuralgic pains in the cheek, extending to the eye and forehead, are common. Swelling of the nose, inner part of the eyelid, and cheek on the same side as the foreign body has been described in a number of cases. Two cases of meningitis are reported, in one of which a splinter of wood had penetrated the ethmoid bone and caused a rhinolith and suppuration.

Examination of the nose shows it to be filled with purulent secretion and crusts. When these are removed the rhinolith is discovered, usually bedded in granulations or hidden by polypi. As complications, perforation of the septum, ulcerations leading to necrosis of the turbinated bones or nasal floor, abscess of the septum, and empyema of the antrum have been found.

The diagnosis is less easy than it is in the case of simple foreign bodies, for the secondary changes are greater, the granulations and polypoid growths hide the concretion, and it is hard to tell it from osteoma or portions of necrosed bone in syphilis. The disease has also been mistaken for carcinoma. An examination with the probe is the surest means to avoid error. Rhinoliths are to be distinguished from malignant disease by their slow growth and the less degree of pain that accompanies them on inspection and palpation with the probe. Rhinoliths are movable in the nasal fossa, while osteomata are fixed and cannot be penetrated by a sharp needle as can a rhinolith.

Treatment.—The methods of removal of rhinoliths are essentially the same as those employed to extract simple foreign bodies. As they are generally of larger size and rougher material than these substances, they offer more resistance to efforts to withdraw them. It is therefore more often necessary to break them down before removal, and the methods described with foreign bodies will usually suffice for this purpose. In addition to these, lithotrites have often been employed with success, and the rhinolith may be reduced in size by the repeated application of minute portions of mineral acids with a roughened probe, as suggested by Bergeat. In some cases it is better not to attempt to extract the concretion from in front, but to push it into the nasopharynx, while the finger is introduced behind the velum as a guide to keep the rhinolith from getting into the larynx. It can also be seized from the nasopharynx by means of a small-bladed pair of Löwenberg's forceps, after it has been pushed back through the choana. The finger is also to be used here as a guide.

Maggots in the Nose.—Nasal disease due to invasion of the nasal cavity by the larvæ of certain species of flies, though common in tropical countries, is quite rare in temperate latitudes; not so rare, however, as to prevent an extensive literature on the subject. The flies liable to deposit eggs in the human nares belong to the genus *œstrus*, or gadfly

(not the horse-fly), and the muscidæ, or that family of flies to which the common house-fly belongs. Though the larvæ of the genus *æstrus* have been found in the human nose, this is a very rare occurrence as compared with the frequency of those of the genus muscidæ in the same location. Where *æstrus* larvæ live in the human nasal passages they do not cause destruction of tissue, but simply irritate the surface of the mucosa. In this they differ from those of the muscidæ, which may cause the most frightful destruction of the nasal interior. The common house-fly is innocent of causing nasal disease, but some of its near relatives of the genus muscidæ belonging to the order of sarcophagi are dangerous. One variety of these is the sarcophagus *Wohlfahrtii*, a fly resembling the large gray flies seen on carrion. The sarcophagus *Wohlfahrtii* is shy and is found only in the open country. It lays its eggs in the noses of sleepers in the open air in daytime, and is especially apt to do so in the nasal cavities of people with offensive discharges. Another variety of muscidæ is far more dangerous, as it is found in all latitudes from Canada to Central America, is not at all shy, and enters houses, acting as impudently as does the common house-fly or the bluebottle-fly. It will lay its eggs in the nostrils of people who are not asleep, and though it shows a preference for diseased nasal cavities, it does not spare healthy ones. This fly is responsible for most of the cases of maggots or "screw-worms" reported. It causes the disease called Peenash in India, where maggots often cause great destruction of the structures of the nose. This fly is called the *Comptosomyia macellaria*, *Calliphora antropaga*, or *Lucilia macellaria*.

Suppuration ensues, with periostitis, perichondritis, and necrosis of bone and cartilage. All of the soft parts of the nasal interior may be destroyed, the necrotic bones are cast off, and the external nose may be merely represented by its integument. The turbinated bones, the septum, the ethmoid, the sphenoid, the palate, and even the superior maxillary bones may be totally destroyed, and inflammation of the meninges is likely to follow. The soft palate is also in some cases eaten away in the course of time, so that the maggots enter the oral cavity. In one case the hyoid bone was necrosed. The maggots may also work their way through the integument of the external nose. Swellings resembling abscesses form, which burst and discharge the larvæ. In others the destruction is more limited, and produces merely ulceration or necrosis of the cartilaginous septum or perforation of the soft palate.

Symptoms.—The symptoms rapidly follow the deposit of eggs by the female fly, as the eggs hatch in twenty-four hours and the larvæ grow speedily to their full size. At first there are merely irritation and tickling in the nose, with slight discharge; but the tickling rapidly increases to unendurable formication, with violent sneezing. As the larvæ begin their destructive burrowing, pain makes its appearance. Persistent headache, rapidly increasing to agonizing intensity, with exacerbations

four years. They may leave the nose of their own accord, or be sneezed out. Their presence causes severe nervous symptoms and intense local pain, especially great if the insect is in the frontal sinus. Other living creatures that have infested the nose with similar symptoms are the earwig (*Forficula auricularia*), caterpillars, scorpions, and termites. Leeches have been carelessly allowed to crawl into the nose, with such serious consequences in one case that death resulted from prolonged nose-bleed. There are many reports of the appearance of *ascaris lumbricoides* in the nasal cavity and the accessory sinuses, the frontal sinus especially. The nervous symptoms caused by its presence may be severe headache, syncope, and vomiting. The treatment of animals in the nose is essentially that of maggots in the nose. When visible, the intruders can be extracted with forceps.

CHAPTER VI.

CUTANEOUS DISEASES, DEFORMITIES, AND INJURIES OF THE NOSE.

FURUNCULOSIS OF THE NOSE.

THIS affection, though a minor one, is important because of its frequency and the pain and temporary disfigurement it causes. The infection is due to the entrance of staphylococci into the follicles of the vibrissæ within the nostrils. In this situation the furuncles are very hard to see until ready to discharge, as the dense nature of the tissues of the *ala nasi* keeps them from rising above the surface as does the ordinary boil. Furuncles also occur on the outer aspect of the nose. Eczema and the irritation of the cutaneous surface within the nostrils due to nasal discharges predispose to the formation of boils. As elsewhere, one furuncle is liable to be followed by another or several in succession, the redness and swelling of the external nose being often very disfiguring. As soon as the slough and pus are discharged recovery is rapid. Occasionally furuncles in the nasal vestibule lead to abscess formation of considerable extent, with fever and great pain.

Treatment.—If an abscess form, it should be opened as soon as the pus has collected. When the slough is ready to separate a small incision will usually suffice to free it. Until the time has come for incision, cotton moistened with a saturated solution of boric acid should be kept within the nostril to soften the epidermis and permit the boil to open spontaneously. Prevention of recurrence is sometimes accomplished by painting the cutaneous region within the nostrils with a one-half per cent. solution of corrosive sublimate in alcohol, three times daily, or the application, twice daily, of an ointment of corrosive sublimate three-fifths of a grain, distilled water forty-five minims, and enough lanolin to make two and one-half drachms; but in obstinate cases furuncles will recur in spite of all measures. In such instances the urine is to be examined for sugar, as diabetes may exist as a predisposing cause. Of internal remedies potassium chlorate has seemed the most serviceable for the prevention of furunculosis.

LUPUS OF THE NARES.

Lupus is a process much like the slower and less malignant types of tuberculosis, which are accompanied by cicatricial tendencies, and may perhaps present a form of tubercular disease in which the body cells offer unusual resistance to the evil influence of the tubercle bacilli. The opinion of to-day is that tuberculosis and lupus are due to the same cause,—viz., the tubercle bacillus. The disease in the nose is very chronic and

is usually secondary to lupus of the external nose. It generally occurs in young persons of strumous habit and is most liable to affect young girls.

Etiology.—The disease is supposed by the majority to be a form of tuberculosis, but there are good observers who dissent from this view, holding that too much importance is attributed to the scant presence of tubercle bacilli as an etiological factor, and that the disease is essentially different from tuberculosis. It is certain, whatever the relationship between the two diseases, that lupus is often followed by the appearance of tuberculosis elsewhere in the body. Lupus of the nares usually follows facial lupus, but may precede it. Abrasions at the nasal entrance and chronic coryza with eczema narium are conditions greatly favoring infection with the tubercle bacillus.

Pathology.—Lupus of the nares is usually seen in the form of *lupus exedens*, or the ulcerating form. The seat of the disease is almost invariably the cartilaginous septum. From here it spreads to the nasal floor and turbinals. It generally spares the bony structures of the nose, differing in this from syphilis. The characteristic product of lupus (the nodule) appears here as it does on the skin, but differs in its deeper red color and slight elevation above the surface. The size of the separate nodules is that of a millet-seed, and so closely are they usually crowded together that they form an irregular red surface that is firm and infiltrated, resembling somewhat an area covered with red granulations, but much firmer to the touch. The patch of lupus is usually covered by scabs, which need removal before it can be inspected. Ulceration is slow, and shows no great inclination to become deep rapidly, spreading rather on the surface by the formation of fresh nodules while at some other portion of the lesion cicatrization may be in progress, the ulcer thus acquiring a serpiginous character. The margins of the ulceration are generally indurated and slightly elevated, while the ulcer itself is of a shallow, ragged character, until in the course of time it gradually deepens and perforates the septum in its cartilaginous portion. The microscopic anatomy is the well-known one of the miliary tubercle, and tubercle bacilli are usually sparsely present.

In *lupus non-exedens* the new-formed lupous tissue does not ulcerate, but is absorbed and organized into cicatricial tissue, causing retracting scars and atrophy of the structures involved.

Symptoms.—The beginning of lupus is slow and insidious, the first symptoms being those of a chronic rhinitis with watery discharge, that later becomes thicker and shows a tendency to dry in the form of scabs. At the same time the nasal vestibule becomes the seat of an eczematous condition causing fissures and crusts to form on the rim of the nostrils, and the external nose and upper lip are apt to swell at the same time. The patient thinks that he has merely an obstinate cold in the head, and generally puts off going to a physician until the disease has made such progress that its eradication has become difficult or impossible and the

stage, when the disease is circumscribed, it may be eradicated; but if it has made much advance this becomes impossible. The disease shows little tendency to involve the lymphatics or lymph-glands, but may lead to the development of lupus of the pharynx or larynx, or later to the appearance of pulmonary tuberculosis. It is also liable to spread from the interior of the nares to the face.

Treatment.—The destruction of the lupous tissue by curettement and lactic acid has attained the first place among therapeutic methods. All diseased tissue is to be energetically scraped away with the sharp spoon, the instrument penetrating a little into the healthy structures. The friability of the diseased tissues makes them more easy of removal than the healthy ones, so that the resistance offered by these to the instrument indicates how far one must go with the curette. If the disease extend through the septum there must be no hesitation in perforating it. The raw surface left by the curette is to be vigorously rubbed with pure lactic acid. The site of the disease should be closely watched, and all suspicious places scraped away at intervals of from three to six weeks. Among other methods of treatment, cauterization with the galvano-cautery is probably the best and affords very satisfactory results. Complete removal by the knife is sometimes practised.

RHINOSCLEROMA.

Like many other rare affections, this disease is doubtless often unrecognized. Its chief characteristic is the production of a peculiar connective-tissue growth in the mucous and submucous tissues of the respiratory tract. This new-formed connective tissue undergoes hyaline degeneration to a large degree, so that in consequence it forms nodes, tuberousities, and infiltrations almost cartilaginous in hardness. Later the new tissue atrophies and organizes into dense cicatrices. As the disease may invade any portion of the respiratory tract, from the bronchi outward to the external nose, it has been suggested to substitute for the name rhinoscleroma that of scleroma.

Etiology.—The transmission of rhinoscleroma from one individual to another has not been observed, so that there is no proof of its possessing contagious properties.

Pathology.—Rhinoscleroma may be located in the nares, pharynx, larynx, trachea, or bronchi, or may involve several or all of these parts together, and may also attack the integument of the external nose and upper lip. Its characteristic lesions in the nose are protuberances and nodes that rise from the surface of the mucous membrane and diffuse infiltrations of the submucous tissues. The prominences vary from the size of a millet-seed to that of a pea. The diffuse infiltration of the submucous tissue is of a rigid, firm consistency, and greatly obstructs the lumen of the nasal fossa or entirely closes it.

The disease generally originates in the nasopharynx in the salpingopalatal fold, and advances through the nasal cavity until it reaches the vestibule of the nose. Here it usually halts, but often it also invades the external nose, upper lip, and gums. In many cases it is primary in the larynx or trachea, and may cause fatal stenosis of these and the bronchi as it descends.

In the nasal vestibule the disease appears in the form of diffuse infiltration, which may form voluminous folds which protrude from the nostril as bluish-red tumors of the size of a cherry.

It is not usual for the infiltration to go farther than the rim of the nostril; when it does so it may enlarge and deform the nose greatly, so that the latter may even attain the size of a fist. When the upper lip is invaded it assumes the shape of a protruding snout, while the swelling may obliterate the space between the lip and gums. The infiltrated portions of the skin have a cartilaginous hardness, while the cutaneous

surface presents a glazed appearance, as if tightly stretched over the infiltrations. The color of the skin may be white or bluish brown. Nodules of pea size may also be seen upon it.

Though ulceration of the scleromatous tissue is never great, fissures are apt to occur which may become deep enough at the junction of the ala of the nose to the face to sever the ala from its base.

The scleromatous infiltration of the nodules, wherever found, results finally in the formation of cicatricial tissue as the nodules shrink. In this manner the

soft palate becomes drawn towards the roof of the pharynx, making posterior rhinoscopy imperfect or impossible. Retraction and disappearance of the uvula are very characteristic features of the disease, and cicatricial distortion of the Eustachian orifice may result in deafness.

Histologically, the first change is invasion of the tissue by round cells, which later become spindle cells and organize into new connective tissue. Not peculiar to the microscopic appearance of rhinoscleroma, but still very characteristic of it, are the so-called Mikulicz cells. These are large, pale cells which have undergone hyaline degeneration. Hyaline material is also found in the shape of larger spheres or agglomerations of these into masses, or in the form of granules, and the hyaline degeneration may invade the connective-tissue fibres. The hyaline material gives to the scleromatous infiltration its firmness, and is the chief histological characteristic of the disease. A micro-organism, the bacterium of Frisch, exists in large numbers in the Mikulicz cells, and may

FIG. 103.

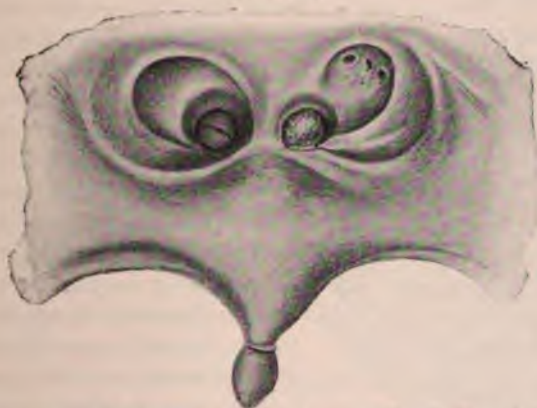


Rhinoscopic image in rhinoscleroma. Both lower turbinates are much infiltrated, causing tumor-like prominences. (Stoerk.)

also be found in the round cells, in the interstices of the connective tissue, and in the epithelial cells. It is surrounded by a gelatinous, brightly refracting capsule, inside of which its body appears as a little dark rod, looking much like a diplococcus in lively motion. These bacteria can easily be cultivated, and resemble the pneumococcus and ozæna bacillus in appearance, but differ from these by their slight virulence and the fact that they do not curdle milk. The bacteria accumulate in collections which are hard to distinguish from the hyaline masses, their translucent capsules causing this appearance. The bacterium of Frisch is considered by most of those who have studied the disease to be its cause.

Symptoms.—At first the patient is troubled with what seems to be a chronic nasal catarrh that extends gradually from the nose to the pharynx and larynx. This lasts, as a rule, for several years, the secretion becoming

FIG. 104.



Both choanæ are narrowed by semicircular folds and membranes. The tubal openings have disappeared as the result of rhinoscleroma. (Stoerk.)

gradually purulent, and finally drying into scabs and crusts within the nares and pharynx. The crusts emit a foul odor that is different from that of ordinary ozæna, and seems to be peculiar to the disease. In this stage the scleromatous tissue begins to make its appearance, oftenest first on the salpingopalatal fold. Next in frequency it makes its first invasion in the choanæ, less often in the larynx, still less often in the pharynx, and with least frequency in the trachea. From these first sites the scleromatous tissue spreads, and finally invades large parts of the respiratory tract, even narrowing the bronchi. Usually not until the disease causes marked obstruction to breathing does the patient, who is generally of low intelligence, seek relief. Another reason for the patience with which the affection is endured is its painlessness and extreme chronicity, decades passing before there is any appreciable advance.

olfactory nerve-cells, epithelial metaplasia, and enlargement of the nasal passages are the probable causes of this form of anosmia. Neuritis following diphtheria or influenza may lead to loss of the sense of smell if the olfactory nerves be involved. Dryness of the mucosa of the olfactory fissure may cause hyposmia or anosmia. The removal of the Gasserian ganglion in human beings results in a marked diminution of the acuteness of the sense of smell, the reason of which is not understood.

Central anosmia may be caused by atrophy of the olfactory bulbs or by their injury in fractures, such as those of the cribriform plate. Intracranial diseases may be the origin of this form of anosmia by pressure on the olfactory bulbs, and tumors, especially those of syphilitic origin, meningitic exudates, extravasations of blood, or subdural abscesses in the anterior fossa of the skull may produce this. Gunshot injuries of the olfactory bulb have caused anosmia. Although the cerebral centre of the sense of smell is unknown, it has been observed that dropsy of the ventricles, embolic, hemorrhagic, and sclerotic changes in the cerebral substance, and brain-abscess may result in anosmia. It is also one of the rarer manifestations of hysteria.

The prognosis of essential anosmia is according to its cause. When this is central the outlook is usually bad, except in those cases due to the presence of syphilitic gummata. Diphtheritic and influenza anosmias generally recover. The treatment must be guided by the etiology. In neuritic cases the local application of strychnine solutions has proved of benefit. Syphilitic cases are to be treated by large doses of potassium iodide.

Hyperosmia.—There are considerable variations in different individuals in the acuteness of the sense of smell, so that its pathological intensification can be predicated only when it becomes an annoyance to its possessor. The condition may also be one of increased irritability of the individual rather than of extraordinary acuteness of smell, so that odors which do not disturb or may even please others are disagreeable to him. This explains the fact that hyperosmia has so frequently neurasthenia, hysteria, anæmia, or pregnancy as a basis, and, in short, generally occurs in people either temporarily or chronically nervous. Such people may find minute amounts of tobacco-smoke and the odors of certain flowers or drugs intolerable, and may even be subject to reflex disorders in consequence, such as headache, vomiting, palpitation, faintness, and asthma. Hyperosmia of this type occurring in nervous, hysterical, or anæmic individuals is doubtless central in origin, and has its seat in the cerebral hemispheres. Respiratory hyperosmia may exist when the air-current is for some reason unduly deflected into the olfactory fissure. Toxic hyperosmia may result from the local application of strychnine to the olfactory mucosa, and may also follow its general use.

Treatment.—Toxic hyperosmia and that due to pregnancy depart with their causes. The form accompanying neurasthenia or hysteria may be improved or relieved by those remedies which make the body more robust and the nervous system more resistant to impressions. In addition to this the local application and general use of potassium bromide have proved of service. The disease may be extremely obstinate and intractable, and in many cases incurable. Potassium bromide is to be used in the form of a spray in a one or two per cent. solution. Weak solutions of astringents may also be tried, but are not well borne in the upper part of the nose.

Parosmia.—In parosmia there is perversion of the sense of smell; odors are not perceived correctly, or else the individual is conscious of odors which do not exist, but are subjective, a condition analogous to tinnitus aurium. Those odors which are due to putrid intranasal or pharyngeal conditions, and are noticed only by the individual,—so-called kakosmia subjectiva,—are commonly considered with true nervous parosmia.

Parosmias of nervous origin occur in neurasthenic, hysterical, or pregnant persons, and often in those mentally diseased. The subjective odors perceived are usually disgusting or disagreeable. Parosmia may follow influenza, and here it is probably due to direct irritation of the olfactory mucosa. It may precede epileptic attacks as an aura. When this occurs it is always well to examine the nose for diseased conditions, especially empyema of the sinuses, as some cases of epilepsy have been relieved by treatment of such states. Parosmia may be due to disease of the olfactory bulb or tract, the gyrus occipitotemporalis, the gyrus hippocampi, and the pes hippocampi major.

Diagnosis.—The diagnosis of purely nervous parosmia is to be accepted with extreme caution, as subjective perception of foul odors is often due to some local diseased state. The cases of parosmia due to central causes are usually not capable of improvement. Those caused by influenza recover. Local causes for subjective bad odors are to be carefully searched for. Those cases dependent upon neurasthenia and other general nervous states should receive the same treatment as for hyperosmia.

CONGENITAL DEFORMITY OF THE NOSE.

The nasal passages may be congenitally occluded in their anterior portion by a cutaneous diaphragm, while the choanæ, when closed, are occluded by bone, a plate of this being derived from the vertical portion of the palate bone. Membranous closure in this region is not congenital, but always the result of syphilis, diphtheria, or other disease process. The bony plate is covered on both sides with mucous membrane, is very thin, and is placed not exactly transversely and vertically, but, as a rule, somewhat obliquely. In these cases anosmia exists until the obstruction

is removed, when the sense of smell gradually returns. The occlusion is usually bilateral, but may exist on one side only.

Double septum (duplication of the vomer), supernumerary turbinals, extension of the vomer back to the base of the skull and vertebral column, and teeth growing into the nares, usually incisors or canine teeth, are curiosities which merely need mention. The congenital deficiencies in the nasal skeleton belong to the domain of harelip and cleft palate, and can be studied in works on general surgery. Congenital perforations, or almost entire absence of the cartilaginous septum, are occasionally found. Narrowness of one nasal fossa is a common condition. This usually takes place in the posterior part, the septum and turbinals, especially the lower, approaching one another so that the choana is almost occluded. Septal deviations are doubtless in many cases congenital, but they and their effects will be considered in another chapter. Adhesions between the turbinals and deviated septum are quite common, and many of them are congenital.

Treatment.—Congenital closure of the anterior nares must be opened by incisions, and the opening increased by the introduction of laminaria tents. Later it can be maintained by tubes or pieces of hollow bougies. The occlusions of the posterior nares must be opened at once in infants, as the obstruction to nasal respiration keeps the child from nursing. To accomplish this, a stout probe or the blunt end of Ingals's nasal bone-forceps should be pushed through the obstruction, the cutting edge of the latter being used if needed. In adults and older children the bony plate can be perforated in several places with the trephine, and the opening enlarged with the saw or nasal bone-forceps. A good procedure is to pierce the obstruction with a trocar during general anæsthesia, while the finger is placed in the nasopharynx as a guide.

Adhesions between the lower turbinal and septum should be divided in such a manner that a space remains between the wounded surfaces after the operation. For this purpose Pynchon's or other punch-forceps, which excise a piece, are excellent. Electrolysis will also destroy the adhesion in such a manner that it will not reform. The apparatus and current strength to be employed are the same as those described under hypertrophic rhinitis. Simple division and keeping a foreign substance between the wound surfaces are tedious, and agglutination of the tissues is apt to recur as soon as this is removed.

FRACTURES OF THE NOSE.

Fractures of the nose represent about one per cent. of the total of all fractures, and hence are among the rarer ones.

Etiology.—Fractures of the nose are usually caused by falls or blows.

Pathology.—A common form of fracture is a transverse one of the nasal bones about their middle. In this case the lower fragment is

driven backward, forming an angle with the upper, that remains in place. As the nasal bones are supported only in their upper two-thirds by the perpendicular plate of the ethmoid bone, and below this by the cartilaginous septum, the latter is driven backward with the fractured ends of the nasal bones, and is bent, broken, or dislocated from its groove in the vomer and the superior maxillary ridge, or its anterior inferior angle is detached from its connection with the membranous septum. Another form of fracture or, more properly, dislocation is longitudinal separation of the nasal bones from each other, or the lateral dislocation of both bones together from their attachment to the nasal processes of the superior maxillary bones.

In some cases the nasal bones are driven straight backward between the nasal processes of the superior maxillary bones, and the resulting deformity is very characteristic. A deep groove presents where the nasal bones formerly were, marked on either side by the sharp ridge caused by the projection of the nasal processes of the superior maxillary bones. In some cases the nasal processes are also fractured and driven backward into the nasal cavity, so that the nose is almost effaced. Extreme violence, such as the kick of a horse, may produce comminuted and compound fractures of the nose of a most serious nature. A common form of this accident is fracture of the frontal bones at and above their junction with the nasal bones. In these cases the lower parts of the forehead and nose are driven in and the frontal sinuses exposed. A fatal result is common, as the cranial cavity is usually opened.

In fractures of the nose below the upper thirds of the nasal bones, even if extensive and involving the perpendicular plate of the ethmoid bone, the cribriform plate is not fractured, but in fractures above this point the cribriform plate and the roof of the orbit are generally broken. This alters the prognosis very unfavorably.

Fractures of the septum require separate consideration. Except in cases of extreme destruction, the vomer is practically safe, and the perpendicular plate of the ethmoid is fractured only when the upper half of the nasal bone is driven in, as its attachment does not extend below this. Therefore fractures of the bony septum are rare. Those of the cartilaginous septum, on the other hand, are among the commonest of all nasal fractures, are most apt to accompany the breakage of the lower part of the nasal bones just described, and are usually found in the upper part of the cartilaginous septum, the fracture being generally of a longitudinal character. The septum may be the seat of an infraction and merely bent out on one side, or the fragments may override and be pushed back on one another. In these cases a hæmatoma generally appears on each side of the septum, due to blood effused under the perichondrium and mucous membrane.

Dislocation of the lower border of the cartilaginous septum from the superior maxillary ridge and at times from the upper border of the vomer

is not uncommon. The dislocated edge of the cartilage presents as a whitish ridge of characteristic shape by the side of the anterior nasal spine and may narrow the corresponding naris greatly. In some cases merely the anterior inferior angle of the quadrangular cartilage is separated from the membranous septum.

Symptoms.—Nose-bleed, varying from a few drops to serious hemorrhage, accompanies all forms of fracture of the nose. The deformities mentioned above can be seen only for a short time after the accident, as the swelling which supervenes, and which is due to the effused blood, appears promptly and is great. In most cases the nose is so embedded in swollen tissues that only its general direction can be noted, while its outlines are completely lost. The swelling often spreads to the cheeks and eyelids, causing the latter to puff out. The rapidity and extent of the tumefaction account for the frequency with which nasal deformities after fractures go unrecognized until union has occurred and it is too late to remedy them. Subcutaneous emphysema of the face may occur, especially when fractures involve the antrum or frontal sinus, being provoked by blowing of the nose to remove clots. Concussion of the brain does not occur in simple fracture of the nasal bones. The serious fractures mentioned, involving the frontal, nasal, and ethmoid bones, may be accompanied by fatal cerebral complications, due either to intracranial hemorrhage or to suppuration with purulent leptomeningitis, as in other compound fractures of the skull. Even when the cranial cavity is not opened, these grave compound fractures may cause sinus suppuration and necrosis of fragments, orbital phlegmons, and purulent meningitis, due to the propagation of the infection by means of the veins, especially the ophthalmic and ethmoidal veins.

In fracture of the cartilaginous septum the swelling is apt to take the form of hæmatoma of the septum. In dislocation of the septal cartilage from the vomer, superior maxillary ridge, and membranous septum the nose below the nasal bones loses support, recedes, and its profile shows a depression at this point. This can be effaced by pulling the septum forward with forceps.

Diagnosis.—An early diagnosis is desirable, but not always possible, as the case may be seen when the swelling is fully developed. Here it is necessary to warn the patient that some deformity may remain after the swelling subsides, though all care be used in reducing the fracture. In these obscure cases an X-ray picture of the nasal skeleton should be taken, if possible. In addition to this, in all doubtful cases general anæsthesia should be employed to make the diagnosis positive. Rhinoscopy is always to be used, as the cartilaginous septum is invariably fractured or displaced in all fractures of the nasal bones.

Treatment.—Reposition in cases of fracture of the nasal bones with infraction of the septum is best accomplished by seizing the tip of the nose firmly and pulling it forward, while introducing the little finger into

the narrowed naris and pressing the septum over with it. Once pulled back into place, the structures usually remain in position. In order to make sure of this, however, it is better in most cases to tampon the nares with lint impregnated with bismuth subnitrate or iodol in the manner described under epistaxis. When greater force is needed, the septum may also be pulled forward with forceps with flat, long blades which take hold of a large surface. The blades should have a small drainage-tube tightly slipped over them, so that the mucous membrane shall not be injured. When the nasal bones have been displaced in the same direction, they can sometimes be put back by seizing them with the fingers and pushing them towards their normal seat. When they will not yield, a strong probe or smooth rod, not more than one-eighth of an inch in diameter, is to be passed along the under surface of the nasal bones, and the latter lifted while being pressed back to place with the fingers. A thicker instrument than the one mentioned cannot be passed into the narrow space between the septum and nasal process of the superior maxillary bone. The end of the probe is to be protected with a thin film of rubber in the manner mentioned above. The same instrument should be used to raise the nasal bones if displaced backward. The manipulation should be preceded by local anæsthesia with cocaine. A dislocated septum can be replaced by pulling it strongly forward with forceps and packing the nasal fossæ to retain it in position.

In fractures of the nose as usually seen, plugging of the nares is all that is needed to maintain the fragments in place, being far more effective than any external splint. It is also superior to the springs or tubes devised for use within the nostrils. In those cases, however, in which there is an obstinate tendency to lateral displacement of the nose, an external splint of plaster of Paris may be employed. In all difficult cases narcosis is imperative, as only with its aid can the nose be freely manipulated for purposes of examination and replacement. If the fragments cannot otherwise be reduced, there should be no hesitation in cutting down on the seat of fracture, exposing it over its whole extent, and replacing the broken bones with blunt or sharp hooks or forceps. The remaining scar will not mar the features as much as even a small deformity of the nasal skeleton. Union is usually rapid and without appreciable callus.

CHAPTER VII.

FIBRINOUS AND DIPHTHERITIC RHINITIS.

FIBRINOUS RHINITIS.

Synonymes.—Pseudo-membranous rhinitis, membranous rhinitis.

FIBRINOUS RHINITIS is an acute inflammation of the nasal mucous membrane characterized by great swelling and false membrane on its surface; this is firmly attached to the nasal mucosa. The disease is usually accompanied by slight constitutional symptoms, takes a subacute or chronic course, and shows no tendency to spread to other parts. The false membrane forms again when removed, exposes a bleeding surface if torn away, and when it finally disappears leaves neither scars nor losses of substance. The swelling is usually so great that the affected nostril or nostrils are generally entirely occluded. The swollen mucosa has an oedematous look, and is seen to be normal in color or moderately congested, or sometimes even pale, when false membrane does not hide the tissues from view. The turbinates especially give the impression of a watery, somewhat translucent swelling. Microscopic examination shows the epithelium and submucous tissues to be densely infiltrated with leucocytes. The false membrane contains many micro-organisms, varying according to the case, the most constant being the Klebs-Löffler bacillus, streptococci, staphylococci, and pneumococci.

Etiology.—Though clinically a different disease from nasal diphtheria, modern observers have proved that almost invariably the Klebs-Löffler bacillus is present, so that clinicians regard this microbe as the cause of the disease in by far the larger proportion of cases. The affection occurs almost exclusively in children, though adults have acquired it.

Symptoms.—The disease may begin as a common cold in the head, or be ushered in by fever, the symptoms being surprisingly mild. Beyond a watery discharge, becoming mucopurulent in about two weeks, and occlusion of one or both nostrils, there is generally so little constitutional disturbance that the children go to school or play as usual, the parents considering the matter an ordinary cold. The symptoms are not invariably so slight as this, however, as there may be fever for a week or two, and grown people have complained of great depression while the disease lasted. The membrane does not extend to the tonsils or pharynx, but remains confined to the nares. The chronic course of the disease—from six to eight weeks—usually leads the parents to seek medical advice. Inspection usually shows both nostrils involved in the disease, though

the ailment may be unilateral. The nares are generally entirely closed by the swollen mucosa, which may be covered in part or completely with gelatinous fibrinous masses. Ordinarily the turbinates are so swollen that they lie in contact with the septum, so that only the anterior edge of the false membrane may be visible as a yellowish-white streak. In other cases the swollen lower turbinate projects so far forward that it looks like a tumor partly covered with a fibrinous coat. If picked off, the membrane is soon renewed. For a long time there is a tendency to crusting and purulent discharge, until the parts finally return to their normal state. The irritating secretions often excoriate the upper lip and nostrils.

Diagnosis.—Clinically, the disease offers a decidedly different picture from the classic cases of diphtheritic rhinitis; in this there are severe constitutional disturbance, headache, weakness, fever, with profuse purulent discharge, often of a foul odor, and preceded for some days by serous, often sanguinolent, secretions. The chief characteristic of nasal diphtheria, however, is its tendency, unlike fibrinous rhinitis, to spread to the nasopharynx, tonsils, larynx, and trachea. Such cases are often not diagnosed until the spread of the disease explains the nasal symptoms. Rhinitis fibrinosa is not followed, as is diphtheria, by nephritis or paralysis. The glands are not swollen in fibrinous rhinitis, while in diphtheria the submaxillary and cervical lymphatic glands are commonly involved. Fibrinous rhinitis is undoubtedly, in some cases, a mild form of nasal diphtheria that may convey the disease in a severe form to others. For a proper diagnosis cultures must always be made.

Prognosis.—Fibrinous rhinitis is generally of a benign nature, and runs its course in from four to eight weeks without complications. This, however, is not always the case, as diphtheritic symptoms have occasionally appeared late in the disease.

Treatment.—As virulent Klebs-Löffler bacilli have often been found in the exudate, the patient should be isolated and precautions taken as in diphtheria. All nasal secretions should be collected in cloths, which are to be promptly burned. The child must not be allowed to associate with other children. Those who have been in intimate contact with it had better receive a prophylactic injection of from three to five hundred units of diphtheria antitoxin, provided cultures show the presence of Klebs-Löffler bacilli. In spite of the mild nature of the disease, it is better to give the patient an injection of one thousand units of antitoxin at once, even before the results of cultures are known, as delay diminishes the effectiveness of the remedy, and it is desirable to bring the disease to a speedy end, as the patient is a menace to all about him. There is, however, not that urgency that exists in diphtheria, and, if it be preferred, there can be no serious objection to awaiting the results of culture experiments.

In a case of two days' duration, seen by O. T. Freer, the membrane

disappeared in two days after antitoxin was injected ; so that, considering the usual chronic course of the disease, it is reasonable to suppose that the remedy acted efficiently.

In small children but little can locally be done on account of their struggles. In older children and adults in the first days of the disease the intense swelling that closes the nose completely makes local applications impossible unless the nasal mucosa can be made to retract sufficiently by cocaine applications, in which case iodol can be insufflated with benefit. No attempt should be made forcibly to remove the fibrinous masses, as it would denude the tissues of epithelium and so expose the blood- and lymph-vessels to the absorption of toxins.

Later, in the stage of suppuration, if there be much secretion this can be removed in the way described in the treatment of acute rhinitis. If it be possible to use it, irrigation with weak potassium permanganate solution, one-eighth of a grain to the ounce, will be most effective.

For dissolving the crusts and dry scales apt to form in the nostrils towards the end of the disease oily sprays are to be used. The excoriation and eczematous patches prone to form on the upper lip and nostrils may be treated with benefit by an ointment containing ten grains of salicylic acid to one-half ounce each of lanolin and vaseline.

DIPHThERITIC RHINITIS.

Diphtheritic rhinitis occurs in a primary and secondary form. Primary diphtheritic rhinitis has been considered in the article on fibrinous rhinitis.

Secondary nasal diphtheria is consecutive to the usual form of the disease on the tonsils, uvula, and in the oropharynx. From these regions the diphtheritic process ascends to the choanæ along the dorsum of the uvula and by way of the nasopharynx. Its appearance in the nose is preceded by the symptoms of acute rhinitis. Intense swelling of the mucous membrane of the nose follows this, and soon produces total occlusion of the nares. The secretion is at first mucous, but with the appearance of the false membrane it becomes thin, watery, and often sanious in character. The discharge irritates the nostrils and upper lip so that these soon present a red, swollen, and excoriated condition, and the excoriations may become the seat of diphtheritic membrane. Within the nares the false membrane may adhere so lightly in places that pieces of it are cast off and blown from the nostrils, while in other places the membrane is firmly attached and may even penetrate the tissues beneath the epithelium. When this occurs, ulcerations remain after the membrane is cast off, and may lead to adhesions within the nares. Inspection may show yellowish-white masses of membrane protruding into the nasal vestibule. When these are removed the mucous membrane underneath is found red, swollen, and

bleeding. When the false membrane is loosely attached to the mucous surface and cast off, it is usually rapidly reproduced, and this process may be repeated several times before it ceases to appear. In some cases fibrinous casts of an entire meatus are discharged from the nose. When the membrane penetrates the mucous surface deeply, it adheres until it is cast off by suppuration, leaving a granulating surface behind which may again become diphtheritic or heal over. As recovery begins the secretions lose their watery character and become purulent. Nose-bleed occurs with comparative frequency, and is usually of bad omen: in hemorrhagic cases, with grave symptoms of septic or diphtheritic general toxæmia, it may prove fatal. If secondary infection with saprophytic germs be added to that due to the diphtheria bacillus, the membrane becomes gangrenous, together with the parts it has invaded. The false membrane softens, swells, becomes discolored and pasty, and when there is hemorrhagic transudate into it it may become black. The discharge acquires a fetid, cadaverous odor, while its intensely irritating properties cause great redness, swelling, and excoriation of the upper lip and nostrils. The patients are apt to be somnolent, while the foul discharge runs freely from the nose and mouth. In many cases the system is overwhelmed by the septic poison and death ensues. In those cases which recover the gangrenous portion of the mucosa is cast off as a slough, but the defects left in the mucous surface after this process are frequently surprisingly insignificant considering the gravity of the inflammation.

The gangrenous processes in the mucosa may also be due to the great depth of the diphtheritic infiltration, which shuts off the blood-supply from portions of the mucous membrane. In these cases, in places in which the nasal surface is uncovered by false membrane it presents a livid red appearance. Hemorrhages also occur into the mucous membrane and beneath the false membrane on account of the stagnation of circulation. The dead tissue becomes putrid and the nasal discharges acquire a foul odor. The granulating surfaces left after the slough has been cast off may form adhesions between different portions of the nasal interior, chiefly the septum and turbinates.

When secondary diphtheria attacks the nose almost at the same time that it makes its appearance in the fauces, experience shows that the case is likely to be one of great gravity. Nasal diphtheria is apt to take a more tedious course than diphtheria in the pharynx, lasting normally about three weeks, though cases of six weeks and longer are not rare.

Diphtheria may have its inception in the choanæ and spread thence to the nares and pharynx. Diphtheria of the nose secondary to diphtheria of the pharynx presents no difficulties in diagnosis. In primary diphtheria of the nose a diagnosis is to be made from those cases of membranous rhinitis due to streptococci, staphylococci, and pneumococci,

and cultures from the membrane are needed to determine the presence of the Klebs-Löffler bacillus.

Treatment.—Of first importance is prompt treatment by diphtheria antitoxin, as mentioned in the treatment of fibrinous rhinitis. Syringing the nose in little children in the manner described under acute rhinitis, and irrigations in older ones, may be needed to cleanse the nares of false membrane when this is loose and to remove pus. Potassium permanganate in the strength of one grain to the ounce may be recommended for this purpose. A powder consisting of three parts of iodol and one part of papain may be insufflated with advantage.

CHAPTER VIII.

CHRONIC RHINITIS, SIMPLE AND INTUMESCENT.

Synonymes.—Rhinitis chronica, chronic catarrh, chronic coryza.

THE term chronic rhinitis embraces chronic inflammation of the nasal mucous membrane and its results, hypertrophy and atrophy, which may outlast the inflammatory process. It is characterized by moderate or excessive discharge from the nose, or by absence of all discharge, or by drying of the secretions within the nasal cavities in the form of crusts. The mucous membrane may be of normal thickness, or merely subject to intumescence capable of temporary disappearance, or it may be in a state of more or less complete atrophy, or in a permanently thickened and hypertrophied state. Thus the capacity of the nose for the passage of air may vary from nearly complete obstruction to abnormal roominess. Chronic rhinitis, therefore, offers such extremes of difference, as regards symptoms, that observation has taught that the varying aspects of the disease are parts of the same process. The widely differing states presented by chronic rhinitis have made it customary to divide its description into four varieties, though the fact is understood that, with the exception of atrophic rhinitis, these varieties are all in relation to one another as stages of the same general disease process, and that they merge insensibly one into the other as this progresses. The most recent investigations have made the connection of atrophic rhinitis with the other forms of chronic rhinitis doubtful in many cases.

The four varieties of chronic rhinitis to be considered are simple chronic rhinitis, intumescent rhinitis, hypertrophic rhinitis, and atrophic rhinitis.

Etiology of Chronic Rhinitis.—As the etiology of the first three varieties of the disease is the same, their causes will be described together, while those of atrophic rhinitis will be considered separately.

Anything that keeps the nasal mucous membrane in a state of persistent irritation may lead to chronic rhinitis. The traumatism to the mucous surface due to the inhalation of substances chemically or mechanically damaging to the delicate epithelium of the nasal passages, if continuous or often repeated, is apt to lead to chronic rhinitis. The same is true of frequent colds in the head. The anatomical changes created by these have not time to be removed before a fresh attack replaces them and the local circulation has been so much deranged that a return to the normal state becomes impossible. At the same time metaplasias of the epithelium occur which cannot readily be restored, so that the frequent action of pernicious agents at last creates, as it

were, a new mucous membrane differing histologically from the normal state, and one that will not return to this even if the causes of the disease originally active cease to be operative. Chronic rhinitis is to some extent an occupation disease, as millers, stonecutters, and those engaged in the multitudinous occupations in which dust abounds in close rooms are liable to it. Workers in chemicals (sulphuric acid, potassium bichromate, arsenic, phosphorus) are subject to the disease, while those exposed to the hardships of outdoor weather and cold winds seem to acquire immunity from rather than a tendency to chronic coryza. As all people exposed to the causes mentioned do not suffer from chronic rhinitis, it seems that a predisposition, either general or local, is needful to develop the disease. General predisposing causes are debility and lowered vitality, inactive life, relaxation due to life indoors, lack of fresh air, and venous congestions caused by stooping over desks or work-benches. Mercury has been accused of rendering those using the drug susceptible to chronic coryza, chronic rhinitis following the use of the iodides is at least rare, and it is probable that so-called scrofula is a sequela of acute and chronic coryza rather than a predisposing cause.

Local causes are all things narrowing or occluding the nasal passages, as ecchondroses, exostoses, septal deviations, and excessive size of the turbinated bones. These may lead to chronic rhinitis, but usually to the intumescent rather than the simple chronic or hypertrophic form. The effect of nasal obstructions is to make it difficult to remove the nasal secretions, and the excessive rarefaction of the air back of them during inspiration favors venous stagnation. Though hypertrophies of the faucial and pharyngeal tonsils are alleged causes of chronic rhinitis, it is rarely associated with such conditions. Postnasal catarrh is to be considered as coexisting with chronic rhinitis rather than as causing it. Chronic coryza is symptomatic of sinus disease, caries of the nasal skeleton, or the presence of foreign bodies. As Hajek states, bacteria play but a secondary rôle in the causation of chronic coryza. Children are predisposed to simple chronic rhinitis, especially the purulent form, and the child with the chronically running nose is familiar to all. With the exception of the atrophic variety, men are more liable to chronic rhinitis than women, occupation having doubtless an influence on this malady.

SIMPLE CHRONIC RHINITIS.

Simple chronic rhinitis is a catarrhal inflammation of the mucous membrane attended by little swelling and characterized generally by great irritability and susceptibility to acute exacerbations. It is attended by congestion and by watery mucopurulent or purulent secretions, which may be excessive. The mucous membrane is evenly and moderately swollen and reddened, but at times the turbinals show more swelling than

the rest of the surface of the nasal passages, the swelling having a hyperæmic character only. A good deal of secretion, either simply mucous in character or mucopurulent, is found in the nose, and in the purulent forms, pus. Ulceration is absent, but erosions may be present, and crusts are apt to form at the nasal entrance and on the anterior part of the nasal septum. Removal of these with the finger-nail is sometimes the cause of ulceration, and finally of perforation of the cartilaginous septum. Microscopically, the epithelium and subepithelial tissues are found infiltrated with round cells, which collect especially about the glands and vessels. The layers of epithelium are increased in number, the upper layer of cells becoming cuboid or flattened into pavement epithelial cells, while islands of normal ciliated epithelium are found between the areas of epithelial metaplasia.

Symptoms.—The patient experiences itching, burning, and tickling sensations in the nose, sneezing usually occurs on the slightest provocation, while headaches and pain in the eyes are frequent symptoms. Not infrequently there are loss of the sense of smell and partial deafness, the sense of taste may be obtunded, and profuse lachrymation sometimes occurs. Nasal respiration is not obstructed except by the accumulation of secretions, especially if these dry at the entrance of the nostrils.

The quantity of nasal secretion varies from a slight increase above the normal to large quantities of watery discharge causing great discomfort. In other cases the nasal secretion is mucopurulent and at times purulent, and there is a tendency for the secretions to dry and crust in the anterior part of the nose. Inspection shows the entire mucous membrane evenly swollen and red, but rarely is there enough swelling to cause obstruction to breathing, which depends chiefly on the accumulation of secretions. After the disease has lasted some time the metaplasia and thickening of the epithelium give a whitish color to the surface.

Diagnosis.—The diagnosis is difficult only in cases with purulent secretion, as here disease of the sinuses, especially of the sphenoidal sinus and ethmoidal labyrinth, may have to be excluded. In sinus disease the discharge is usually unilateral and very often fetid. The ordinary forms of simple chronic rhinitis can be diagnosed by inspection and from the history. When there is a free watery discharge hay fever may be suspected, but this occurs only at certain seasons of the year, and is usually accompanied by marked tumefaction of the mucous membrane of the turbinates. In little children with purulent rhinitis syringing must precede inspection for purposes of diagnosis, or the Politzer inflation-bag may be used to blow the secretion from the nostrils, care being taken that the nostril not used for the insertion of the olive-shaped tip of the air-bag be left open for the exit of secretions, otherwise the surgeon is liable to force pus into the middle ears and establish an otitis media. The method of syringing is described under treatment of acute rhinitis. As the

accessory sinuses are but little developed in children up to the period of second dentition, sinus disease can practically be excluded in them up to that time. This is an aid in diagnosis, as purulent rhinitis is commonest in children and examination most difficult.

Prognosis.—The affection runs a tedious course, sometimes lasting for many years. Though some cases eventually recover spontaneously, others go on from bad to worse, and finally terminate in some of the other forms of chronic nasal catarrh. The simple form of chronic rhinitis may become purulent on account of secondary infection with pyogenic germs, this being most apt to occur in children. Acute blennorrhœic catarrh of the nose, if neglected, may result in chronic rhinitis with purulent secretion.

Treatment.—The avoidance as far as possible of those conditions producing chronic rhinitis and mentioned in the etiology of the disease is the first essential. Chronic rhinitis so often depends on a low state of the general health, due to underfeeding, digestive disorders, and sluggish habits of body producing venous stagnations, that only the physician well versed in the treatment of the general disorders of the body can efficiently treat it.

For the local treatment the indications are to remove irritating discharge, to diminish its production, to disinfect the nose if the secretion be purulent or offensive, and to remove crusted material. When the discharge is free and watery, it needs no washing for its removal, but when it is thicker, irrigations or sprays are needed. Watery sprays are quite sufficient for cases in which the discharge is moderate in quantity and fairly fluid, but when it is thick and purulent or mucopurulent, irrigation is needed. The nasal douche involves the danger of water's entering the middle ear and carrying infectious material with it, thus causing suppurative otitis media. The nasal douche washes chiefly the lower meatus and floor of the nose, leaving the upper portion of the latter and the nasopharyngeal vault uncleansed. The hard-rubber irrigating tube (Fig. 102) mentioned under treatment of acute rhinitis is efficient and safe, and will free the recesses of the nose, its upper passages, and the vault of the pharynx of foreign matter, and it may be given to the patient to use.

The removal of drying or crusting material is best accomplished with the aid of oily substances, and when there are crusts to wash away it is a very essential preliminary to oil the nasal passages an hour or so beforehand, as the oil dissolves crusts and tough glue-like masses of secretion. Oleum petrolatum album or vaseline may be sprayed into the nose, or fluid vaseline may be used in a metal atomizer designed for heating these materials, or be applied with a common sewing-machine oiler. For cleansing purposes oil may also be dropped into the nostrils with a medicine dropper, or the mucous membrane may be painted as far back as possible with vaseline applied with an artist's small paint-brush on a long, slender handle. Oil has a tendency to spread,

so that a small quantity will soon extend over a large surface. The thick oils will stay longest in contact, and are therefore preferable for dissolving crusts.

As a disinfectant wash a solution of potassium permanganate is the cheapest and most efficient. It acts in the weakest solutions, which makes it possible to use it without irritating the mucous membrane, while the ordinary antiseptics, such as carbolic acid, resorcin, or the many proprietary compounds of antiseptics, to be efficient have to be used in such strength that their employment is injurious and unendurable to the sensitive nasal mucous membrane. Hydrogen dioxide, while similar in action to potassium permanganate, does not seem to be as efficient as the latter in a solution of one or two grains to the pint of water.

The number of remedies employed to diminish the quantity of nasal secretion emphasizes the difficulty of such a task. The first class of remedies to be considered includes the astringents. The mucous surface of the internal nose is so very sensitive that the weak strength in which these have to be employed probably accounts for their ineffectiveness in chronic rhinitis. The zinc salts and alum have a reputation for doing permanent injury to the sense of smell. In some rare cases the astringents are of benefit. Good examples are silver nitrate, one grain to the ounce of distilled water, and copper sulphate, three grains to the ounce of water. When they are of benefit the astringents do good by creating active hyperæmia, which causes the absorption of inflammatory exudates in the mucous tissues and reduces the irritability of the mucous membrane. The astringents should be used in spray form. An oily spray of from ten to twenty grains of terebene to the ounce of oleum petrolatum album is one of the most efficient local applications.

Powders blown into the nasal cavity are often useful, Bresgen having recommended pure sodium sozoiodolate as a powder that rapidly diminishes secretion. A sedative powder consisting of from five to ten per cent. of boric acid, twenty-five per cent. of iodol, five per cent. of starch, and enough sugar of milk to make one hundred grains, with occasionally one per cent. of cocaine, may be found of much benefit.

F. Klemperer recommends *iodi puri*, 1; *potassii iodidi*, 2; glycerini, 20, as a pigment to be painted on the mucous surface. Pure boric acid or bismuth, in powder, is at times efficient.

Before any local application can be of benefit the nasal passages must be freed from secretion. Certain patients in whom there is marked hyperæsthesia of the nasal mucous membrane, upon going into the wind or dust are subject to attacks of sneezing accompanied by excessive secretion, necessitating almost constant use of the handkerchief. There is consequently soreness of the nose, the source of much annoyance. This is a most obstinate variety of simple chronic rhinitis, but fortunately it is rare. In searching for the sensitive spots in these cases, a probe should be passed to the back part of the nasal cavity and drawn

forward over the various parts of the mucous membrane; as a sensitive spot is touched, the patient winces from the pain or inclination to sneeze or cough, and sometimes says that the probe pricks or burns. The most efficient treatment is superficial cauterization of the sensitive areas, as practised in the treatment of hay fever. Sedative powders and sprays should be used in the intervals between the cauterizations, which should not be made oftener than once in from five to seven days. The cauterizations destroy the terminal fibres of the hypersensitive nerve, but are not deep enough to destroy the mucous membrane.

INTUMESCENT RHINITIS.

As there is a vasomotor form of acute coryza with swelling due to dilatation of the lacunar veins of the erectile tissue of the turbinals, as, for example, hay fever, rose cold, etc., so there is a chronic form of this condition which might be called coryza vasomotoria chronica, but which is known as intumescent rhinitis. Its characteristic is a persistent tendency to tumefaction of the inferior and often the middle turbinals, and occasionally the tuberculum septi. These swellings are often unilateral, and may change from one side to the other or temporarily disappear.

Pathology.—The pathological changes are those of simple chronic rhinitis just described, but in addition there are localized swellings, chiefly of the inferior and often also of the middle turbinals, the result of a paretic state of the muscular elements of these structures and of the muscular walls of their cavernous veins, which remain in a chronically distended condition. In intumescent rhinitis there is usually but little excess of discharge, though occasionally it is great, and presents the variations described under simple chronic rhinitis. As in simple chronic rhinitis, the pharynx and larynx are apt to be found in a catarrhal state, especially if the intumescence be sufficient to cause mouth-breathing.

Symptoms.—The symptoms of intumescent rhinitis differ from those of simple chronic rhinitis chiefly in the predominance of nervous phenomena due to an exaggerated sensibility of the sensory nerves of the nose not generally found in the simple forms of the disease. The local symptom caused by the irritation of the sensory nerve-ends in the nose is a reflex paresis of the muscular coats of the lacunar veins and the muscular elements of the mucous membrane of the turbinals and portions of the septum. This results in venous stasis and hyperæmic swelling of these parts, so that the patient's chief complaint is of obstruction to breathing through the nose. This obstruction may be unilateral or it may occlude both sides of the nose. It fluctuates, being so slight at times as to cause only a little annoyance, or so great at others as to stop nasal breathing altogether. Fear of an examination or the touch of a probe may cause the unstriped muscle-fibres of the turbinals to contract and the swelling to recede at once. At night the swelling is apt to be worse, as the shallow breathing of sleep and the recumbent posture

favor venous congestions of the head, so that these patients often lie with their mouths open and snore. Deep, full respirations through the nose have the tendency to relieve venous congestions, and therefore deep inspiration with the head thrown back is one of the means of relieving nose-bleed. The chest drawing in air through the comparatively narrow orifice of the nose has a reserve of negative pressure to spare, which is used to draw blood into the vessels of the lungs from the veins. When one breathes through the mouth, the air rushing into the lungs through its wide orifice enters without resistance, so that there is no reserve suction force left for the aspiration of blood from the veins into the chest cavity. It can be seen from this that mouth-breathing establishes a vicious circle by favoring venous stagnations in the nose. The nasal obstruction makes sleep restless and disturbed by dreams, so that the patient wakes up unrefreshed and often with a headache. Sudden changes of temperature, as in going from a cold to a hot room or the reverse, will result in a sneezing fit with sudden nasal occlusion. Though the inhalation of cold air will sometimes add to the swelling, usually this act will clear the nostrils, while the vigorous contraction of the unstriped fibres of the skin caused by a cold shower is generally accompanied by a similar retraction of the nasal mucous surface with temporary relief.

The second nervous phenomenon accompanying intumescent rhinitis is sneezing. This is so easily aroused that even stepping into a bright light may excite this reflex through the unusual channel of the optic nerves. All things which irritate the nerve-ends of the nasal mucous membrane will often give rise to paroxysms of sneezing.

The third nervous symptom referable to this disease is pain. In the nose itself feelings of fulness, dryness, or stuffiness take the place of this symptom, but the irritated condition of the nasal mucous surface will cause reflected pain to be felt in neighboring nerves, such as neuralgia in the region of the distribution of the supra-orbital nerve and in the temples or in the occipital region, or there may be hemicrania accompanying diseased conditions of the upper parts of the nose. Bresgen has recorded cases in which pain in the arms or chest disappeared as a result of treatment of intumescent chronic rhinitis. It is not to be supposed that these neuralgias are frequent accompaniments of intumescent rhinitis; on the contrary, they are very rare conditions.

The fourth group of nerve symptoms is referable to the cerebrum. Patients complain of heaviness, dulness, or inability to concentrate the mind (aproxia), with loss of memory. Nightmares and restless sleep are also common accompaniments of intumescent rhinitis.

Distant reflexes are to be viewed with scepticism. Asthma often coexists with intumescent rhinitis, but only when it disappears as a result of treatment of this is it to be regarded as dependent on the rhinitis. The same is true of spasmodic cough and spasm of the larynx. The eye is such a near neighbor to the nose that it is not surprising that ocular

phenomena frequently attend intumescent rhinitis. Lachrymation and photophobia of reflex origin may be constant sources of complaint.

The nasopharynx is nearly always involved in intumescent rhinitis; in fact, it is the seat of some of the most annoying symptoms. The nasal discharges, stagnating on account of the deficient air-current, are prone to flow backward at night and collect on the pharyngeal vault, where they dry, and are removed only by much hawking in the morning, sometimes forming a crust that adheres for several days. As in simple chronic rhinitis, crusts are apt to form in the anterior part of the nasal passages, and at times their removal gives rise to nose-bleed. The irritating discharge causes eczema of the upper lip and rim of the nostrils, with fissures which are sometimes the source of erysipelatous infection. An occasional mortifying accompaniment of intumescent rhinitis is redness of the external nose, said by some to be a vasomotor disturbance.

Laryngitis is a frequent complication of rhinitis intumescens. It may be due to extension of the disease downward from the nasopharynx, or to the strain the larynx is subjected to in its endeavors to overcome the stoppage of the vocal sound-waves by the obstructed nose. Even if there be no actual laryngitis the voice soon tires, especially in singing. Its alteration varies from a slight deadening, noticed, perhaps, only by the patient, to the thick nasal voice of the mouth-breather, with complete obstruction of the nares. The secretion in intumescent rhinitis presents all the variations described in simple chronic rhinitis. It may be free, watery, purulent, or mucopurulent, or it may be very slight, swelling of the turbinates being the only sign of the disease. The same case at different times will vary much in regard to the discharge, as all these patients are subject to frequent exacerbations which they call fresh colds. In the intervals little remains of the disease but the occlusion due to the intumescence, while during the colds the discharge goes through the variations described under acute rhinitis. The mucous membrane is usually congested, and one or both nasal cavities are found to be from one-third to two-thirds closed by swelling of the inferior turbinated bodies. The swelling is not confined to the turbinates, but also often involves the region of the tuberculum septi situated opposite the anterior end of the middle turbinate and the sides of the vomer, as seen from behind by posterior rhinoscopy. The swollen membrane in the region of the tuberculum septi is usually of a slightly deeper hue than normal; that seen with the rhinoscope at the posterior border of the septum is of a grayish color. The posterior ends of the inferior or middle turbinated bodies sometimes appear much swollen and of a grayish hue; but this is more commonly present in hypertrophic rhinitis. By examination with the probe exquisitely sensitive spots are frequently found, irritation of which is apt to excite sneezing. Peculiarities of the swellings are that a probe will sink into them as if they were air-

cushions until it reaches the bone and that they will generally nearly disappear under the influence of cocaine applications. The swellings will sometimes decrease as the result of exercise, the venous congestion being relieved by the deep inspirations. Fear or pain caused by the touch of the probe may cause them to retract; this, however, may have the reverse effect and increase the swellings. Posterior rhinoscopy will often show a mass of thick pus or a crust on the vault of the nasopharynx. The nares may be free from secretion; in fact, in the intervals between colds this is usually the case.

Diagnosis.—The affection is to be distinguished from simple chronic rhinitis, from hypertrophic rhinitis, and from nasal mucous polypi. Intumescent rhinitis is to be diagnosed from simple chronic rhinitis by the absence of swelling in the latter. If the nasal passages be found free and yet there be a history of repeated obstruction, the patient must be told to return, so that his nose can be examined when the occlusion is present, as the obstruction complained of might have been due to retained secretion. In hypertrophic rhinitis the swelling will perhaps be uninfluenced by cocaine or disappear only in part. The swelling is apt to have an uneven, nodular appearance in the hypertrophic form of chronic rhinitis, and there is also permanent and not intermittent nasal obstruction. Only the inexperienced could mistake nasal mucous polypi for intumescent rhinitis. Their mobility, translucence, and the facts that a probe will move them back and forth, and that it can be passed on either side of them, are sufficient guides in the diagnosis; furthermore, cocaine has no effect on the size of a polypus.

Prognosis.—If untreated, the vascular swellings of intumescent rhinitis are liable in time to become true tissue hyperplasias and result in hypertrophic rhinitis. This is not always the case, however, and the disease may go on for years with little change, and in some rare cases may end in recovery. The complications alter the prognosis and are more serious than the disease itself. As long as this lasts the deafness, if it exist, cannot improve, and often grows progressively worse. Under the same conditions the laryngeal complications tend to become inveterate, while the voice of a singer may be ruined by the persistent strain to which it is subjected in the effort to overcome the nasal obstruction to sound. Treatment alters the prognosis favorably so far as the nasal occlusion is concerned, and this can often permanently be removed. Whether the underlying chronic rhinitis will disappear depends much on its course and severity. The general health will usually markedly improve when the nasal obstruction is relieved. Sleep is no longer disturbed, nasal breathing is resumed and is an aid to the circulation, while the many nervous symptoms accompanying the ailment cease to exist.

Treatment.—All things inducing exhaustion and irritation of the nerves are to be especially avoided. The tone of the vascular system

must be sustained by means of cold shower-baths and calisthenics, or preferably out-of-door exercises. Mouth-breathing is seldom merely a bad habit, but is almost always due to nasal obstruction. As it favors increase of the nasal tumefaction, persistent efforts to use the nose for breathing will counteract the bad influence of oral respiration and tend to clear the nose and prevent the more severe forms of swelling of the turbinals. Of course, these efforts are available only when the nose is partly open for breathing. In the same way sedentary habits and shallow breathing favor passive nasal hyperæmia, while active exercise with deep inspirations relieves it. Dust and nasal irritants are to be avoided, if possible, and in cases in which the disease already exists, cold shower-baths are especially to be recommended. Under their influence the erectile tissue of the turbinals contracts physiologically and the nose becomes free for breathing.

Local Treatment.—It is necessary that marked obstructions due to septal deflections or protuberances should be removed before successful treatment of the disease can be expected. In the earlier stages of the affection mild stimulating applications are indicated. These may be made two or three times a week, and consist of aqueous solutions of zinc sulphate, carbolic acid, and zinc chloride of sufficient strength to cause smarting or discomfort for not more than ten minutes. A good formula is— \mathcal{R} Acidi tartarici, gr. i; acidi carbolici, gr. ii; acidi borici, gr. x; zinci sulph., gr. iii; aquæ destil., $\bar{\text{f}}$ i. M. Aqueous solutions may be employed for home use two or three times daily, such as boric acid, ten grains to the fluidounce, or sodium bicarbonate and biborate, of each from one and one-half to two grains to the fluidounce, or distilled extract of hamamelis or of pinus canadensis, from thirty to fifty minims to the fluidounce of water. A saturated solution of boric acid in camphor-water is also a useful soothing application. Oily preparations, such as oleum petrolatum album, containing camphor from one to two grains, menthol from one-half to one grain, oil of cloves from three to five minims, or terebene from eight to twelve minims to the fluidounce, are generally more beneficial than aqueous solutions. The oleaginous liquid alone may be used as a soothing application to prevent the contact of irritating substances with the mucous membrane.

When demanded, the nasal secretions must be removed in the manner described under simple chronic rhinitis, and one cannot hope to accomplish much unless all viscid or crusting material is removed from both nose and nasopharynx. When the discharge is purulent or offensive a solution of potassium permanganate, one-eighth of a grain to the ounce, is indicated as a wash, but when thick, tenacious mucus has to be removed alkaline washes are best, or solutions of common salt.

Intumescent rhinitis is a disease that is especially liable to lead patients into the cocaine habit, the relief given by the drug being so delightful that the temptation to its abuse is great. The continued local

use of cocaine is followed by a paretic state of the muscular coats of the veins of the cavernous tissue of the turbinals, and thus the drug adds to the disease. Cocaine should never be used continuously, but during the exacerbations of the disease its employment cannot always be avoided. If possible, it should be employed only at night to establish free nasal respiration, so that sleep may be obtained. A solution of from one to two grains of cocaine to the ounce of saturated solution of boric acid is sufficiently strong for a spray, of which only a few drops are to be blown into each nostril. Cocaine may conveniently be employed in the form of the following powder: *sodii bicarbonatis*, *sodii biboratis*, aa gr. iss ; *magnes. carb. levis*, gr. iii ; *cocainæ muriatis*, gr. iv ; *sacchari lactis*, q.s. ad gr. c . This may be blown into the obstructed nostril two or three times in twenty-four hours in quantities not to exceed one-thirtieth of a grain of cocaine at a dose. For the application of powders to the nares, a serviceable instrument to give patients to use is a short glass tube about four millimetres in internal diameter and four inches in length, flattened and expanded at one end but round at the other.

It has been found that an extract of the adrenal glands has a

similar effect to cocaine in reducing the congestion and swelling of the turbinated bodies and in contracting the small blood-vessels. An aqueous extract, which is used as a spray to the nose four or five times a day, is the most satisfactory. The formula used is adrenals (desiccated), one drachm; boric acid, sixteen grains; camphor-water (hot), one ounce; distilled water (hot), enough to make two ounces. Macerate for four hours, then filter. This makes a solution that retains its properties and does not decompose for weeks. The sprays may be applied by means of any suitable atomizer. In fully developed cases of intumescent rhinitis the methods mentioned are but palliative, and only to be employed in those who will not consent to more radical ones. It is not necessary, on the other hand, to cauterize every temporary intumescence of the turbinals, and the slighter and not inveterate forms of the disease may be relieved by the general and local measures mentioned. The radical treatment of intumescent rhinitis consists in destruction of a portion of the swollen tissues by the galvano-cautery or by chemical agents, or by removal of as much of the swollen mucous membrane as can be seized in the loop of the cold snare.

FIG. 106.

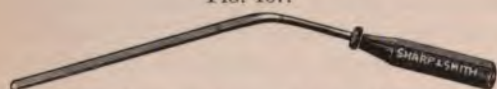


Powder-blower. Three glass tubes (one-third natural size). Straight tube for nasal, bent tubes for nasopharyngeal or laryngeal applications.

Cauterization by Acids.—In the days when galvano-cautery apparatus was cumbersome and expensive the use of chemical agents for nasal cauterization had its reason, but now they have been almost completely supplanted by the galvano-cautery. If an acid be used as a cautery, chromic acid is to be preferred. A few crystals of it on the end of a flat aluminum probe should be held over a flame till the acid fuses, then this should be allowed to cool. The fused acid is then rubbed over the part to be cauterized, which turns brown, and is at once to be sprayed with an alkaline solution. No more acid than will make the

bulk of four or five pin-heads should be used. It should be applied along a strip of membrane one-eighth of an inch wide and from one-half to three-quarters of an inch long. The cauterization may

Fig. 107.



Flat nasal probe (two-fifths natural size). Made of aluminum and bent at an angle of thirty-five degrees.

be repeated, if needed, in from ten to twenty days, when the parts have healed.

Cauterization by chromic acid is followed by a sore that takes longer to heal than that after the galvano-cautery; there is also more pain to be endured afterwards and more discharge, while the results are not as certain and the depth of the cauterization cannot be so accurately controlled.

Galvano-Cautery.—In using the galvano-cautery an electrode with a blade about five-eighths of an inch in length, consisting of No. 21 platinum wire, should be employed. The part to be cauterized is first anesthetized with a solution of atropine, one-tenth grain; strophanthin, one-fifth grain; oil of cloves, three minims; carbolic acid, ten grains; cocaine muriate, twenty grains; enough water to make one ounce; applied with a small cotton swab. When anesthesia is complete the mucous membrane is usually retracted close to the bone and the operation is entirely painless. The wire should become white in two seconds after closing the circuit. Speedy heating makes the wire cut too rapidly and causes bleeding, while a cherry-red heat makes it cut too slowly and gives the heat time to cook the surrounding tissues with consequent severe reaction. Oiling the nose with vaseline makes its introduction easier. To determine the depth to which the electrode should penetrate in order to reach the posterior end of the inferior turbinal, a Eustachian catheter may be passed in and hooked over the posterior border of the septum. Seizing this close to the end of the nose before withdrawing it, and retaining the hold obtained with the fingers, one can use the catheter as a measure of the depth to which the electrode should penetrate in order to cauterize the posterior end of the inferior turbinal.

From one to three cuts are to be made the whole length of the lower turbinal, but only one cut at a sitting, the others to follow at intervals of three or four weeks, when their predecessors have healed.

The electrode having been carried to the back part of the tissue to be cauterized, and turned so that the platinum wire rests against the tissue, the circuit is closed, and as soon as the sound of burning is heard the electrode is drawn slowly forward, or, if the bone be not felt, moved slightly backward and forward until the instrument grazes the bone, and then drawn slowly to the anterior end of the turbinated body, when it should be lifted from the soft tissue before the current is turned off, and then allowed to cool before it is withdrawn from the nostril. If the circuit be broken before the electrode is lifted from the tissue, the eschar is pulled off with it, and bleeding results. The wire should cut through the mucous membrane until it grates on the bone. It is necessary to keep the electrode constantly in motion, as if it be allowed to rest still for an instant it is sure to attach itself firmly to the tissues, from which it has to be torn with resulting bleeding. The other side of the nose can be cauterized in from ten to fifteen days later, but both sides should never be cauterized at one sitting. The cuts are usually made at the junction of the upper and lower thirds of the lateral surface of the lower turbinal with the middle third, but sometimes the lower border needs cauterizing if it be pendulous.

The very objectionable method of making frequent superficial cauterizations should be mentioned here; it accomplishes nothing

but distress and disappointment to the patient. The precision of motion and accuracy of illumination of the deeper parts of the nasal passages required by the operation make its perfect performance a matter of considerable skill and steadiness of hand. If the Eustachian tube be very prominent it might be seared by the electrode, if this be passed too far back. It is well, therefore, for the novice to practise with the cold electrode before turning on the current. Sometimes a single cauterization is sufficient permanently to reduce the swollen turbinal, but more often two or more are needed. Cauterization of the middle turbinal, if intumescent, does not ordinarily give good results. The swelling here is of a watery and dropsical order and less of a true intumescence, and is better removed with the cold snare, if possible.

FIG. 108.



Ingals's cautery electrodes (two-fifths natural size). 1, guarded electrode used for superficial cauterization in hay fever; 2, knife-like electrode used in hypertrophic rhinitis; 3, 4, and 5, electrodes for cauterizing the tonsils, follicles in the pharynx, and small spots in the nose; 5, electrode for base of tongue, or, when guarded by a piece of vulcanite fibre, for nasopharynx; 5, 6, and 7, tubular electrodes, into which various-shaped points of platinum wire may be inserted for various purposes.

Complications.—It is not wise to cauterize a lower turbinal that lies close to the septum either because the turbinated bone is large or the septum approaches close to it by deflection or exostosis. If cauterization be performed in such narrow passages, adhesions are very apt to occur between the turbinal and septum. Here the bony deformity should be removed by operation on the deformed septum or by removal of enough of the enlarged turbinated bone to make room. This can be done by sawing off its free border or by passing a trephine through the turbinal to remove one or more small cylinders of bone beneath the mucous membrane, letting the turbinal collapse.

In some cases adhesions will form at any rate, and it is well to let them alone until they have become organized and put on the stretch by the retracting turbinal, when they can easily be divided with the nasal scissors and kept open with a little lint. If severed while swelling still exists, the adhesions are likely to recur. Follicular tonsillitis and sometimes otitis media have followed the operation, but they are rare complications. Epistaxis may occur as late as the second week, but is seldom severe. Cauterizations should never be extensive or frequently repeated, as death from meningitis or sepsis has followed them.

The after-effects of the operation are seldom more than a coryza with occlusion of the operated side from swelling. This usually lasts not more than from three to five days, and is followed by a watery or mucopurulent discharge, which in the second week becomes scanty, with a tendency to crust. Along the line of the cautery wound false membrane usually makes its appearance and adheres till the second week. A solution of five minims of oil of cloves to the ounce of oleum petrolatum album should be sprayed into the nares immediately before and after the operation. It should be followed by insufflation of a powder of two or three grains of iodol, and a light pledget of cotton kept in the nostril for a few days as a dust-filter. A four per cent. cocaine powder may be given to the patient, with directions to blow into the nostrils three or four times a day if the swelling and headache be severe. Oily applications are indicated during the period when scabs are apt to form, a good formula being composed of thymol, one-third grain; carbolic acid, one-half grain; oil of cloves, three minims; oleum petrolatum album, one ounce. If oily sprays irritate, a solution of boric acid, eight grains to the ounce, will be found beneficial. An excellent after-treatment is that recommended by Bresgen, consisting in painting the cauterized area with a saturated solution of methylene-blue by means of a small pledget of cotton. The application may be repeated once or twice after the operation, but this is seldom needed. This method of after-treatment is usually so efficient that nothing further is required, except in some cases painting the nostrils with vaseline to dissolve scabs or prevent their formation. The inflammatory reaction is decidedly less in those cases which have been treated with methylene-blue. The pharyngeal and laryngeal symp-

ptoms usually improve when the nose is cleared, but may need independent treatment, while the aural complications always demand this. Though one may dismiss patients with all their symptoms relieved, other portions of the mucous membrane sometimes become intumescent, and after a few years further cauterizations may be needed. Other cases may be dismissed entirely cured after six or eight weeks of treatment. Though the cold snare is a very satisfactory instrument for removal of the swellings of hypertrophic rhinitis, it can seldom be employed in the intumescent form of the disease, as the wire loop will usually slip off instead of seizing the protuberant mucous membrane. If this be retracted by cocaine, it is quite impossible to use the wire loop. D. Braden Kyle makes linear incisions instead of cauterizations, and reports better results than from the galvano-cautery.

CHAPTER IX.

HYPERTROPHIC AND ATROPHIC RHINITIS.

HYPERTROPHIC RHINITIS.

In hypertrophic rhinitis the chronic congestion of the nasal mucous membrane has led to a true connective-tissue hyperplasia, localized chiefly on the inferior and middle turbinals and the septum.

Microscopic Anatomy.—In hypertrophic rhinitis the round-celled infiltration so prominent in the simple chronic form has had time to recede, its place being taken by new connective tissue, which later becomes dense and firm. The epithelium shows the same metaplasias as in simple chronic rhinitis, but the number of layers of cells is even greater. The blood-vessels are dilated, and they and the glands are apt to be increased

FIG. 110.

FIG. 109.



Hypertrophy of the posterior ends of the inferior turbinated bodies.



Polypoid swelling on the posterior free end of the middle turbinate. (Stoerk.)

in number in the earlier stages, later lessening again, while in places the vessels become ectatic.

Pathology.—In hypertrophic rhinitis the slight general thickening of the mucous membrane characteristic of simple chronic rhinitis has been replaced by hyperplastic swellings of a localized order. The structure most often showing these changes is the inferior turbinal. Its rich blood-supply and the venous stagnations in the erectile tissue to which this is subject favor an overgrowth of the connective-tissue and bony elements. The whole inferior turbinal is not always involved in hypertrophy, though this may occur. A frequent seat of these abnormal swellings is the posterior end of the lower turbinal, which may be so enlarged that it projects like a spherical tumor into the nasopharynx, and may meet its fellow behind the septum. These posterior swellings are apt to have a

nodular or raspberry-like surface resembling a papilloma; nevertheless, there is in them no histological relation to true papilloma. In extreme cases the hypertrophic portions of the inferior turbinals form apparently lobulated tumors, which have been called papillary fibromata, polypoid angiomata, etc. They are not true tumors, however, but extreme hypertrophies. The color of the swollen portions of the inferior turbinals is usually dark bluish red; but in old cases, when the connective-tissue hyperplasia is great enough to diminish the vascularity, or when the epithelium is much thickened, the color is whitish. The anterior part of the lower turbinal is also occasionally liable to localized hypertrophy. This may be nodular and ridged in appearance, or smooth as in intumescence. The hyperplasias of the middle turbinal are scarcely less frequent than those of the lower; they present a very different appearance, however, being usually confined to the lower border

FIG. 111.



Bilateral hypertrophic swelling of mucous membrane of septum. In the right choana hypertrophy of posterior end of middle turbinal. Complete obstruction of right naris. (Stoerk.)

of the middle turbinal, and occupy it either as a single smooth, translucent, dropsical enlargement or as several polypoid protuberances having a broad base and hemispherical form, so that formations occur suggesting clusters of grapes, from which state it is but a step to the true nasal mucous polypus. The septal thickenings are usually found at the junction of the middle and upper third at the tuberculum septi, and just in front of the posterior free border of the vomer. The posterior swellings are usually pale and smooth, and may be quite large and a considerable impediment to respiration.

Symptoms.—The symptoms are essentially those of intumescent rhinitis, but differ in regard to the nasal obstruction which, though varying in degree, is constantly present, while in intumescent rhinitis it may be temporarily absent. The variations are due to the presence or absence of secretion and to the fact that some degree of intumescence capable of

changes in volume almost always accompanies turbinal and septal hypertrophy. In addition to the obstructed nose, the patient chiefly complains of the annoying secretions which collect in his nasopharynx, and there is often complicating laryngitis. If hypertrophied, the middle turbinal shuts off the olfactory region from the air-current, so that there is frequent anosmia. Frontal or occipital headache and the various nervous symptoms described under intumescent rhinitis also occur, with asthenopia and the ocular complications mentioned in that section.

The mucous membrane, especially over the inferior turbinated body, is thickened, and its surface is usually more or less uneven in appearance, sometimes presenting distinct nodules. The swelling varies greatly at times, being uniform over the whole turbinated body or limited to portions of it. When the posterior end of the inferior turbinated body is hypertrophied it can be seen projecting into the nasopharynx as a rounded swelling, usually having an uneven surface resembling a large raspberry,

FIG. 112.



Thickening of mucous membrane of septum. Nodular swelling of posterior ends of lower turbinates. (Stoerk.)

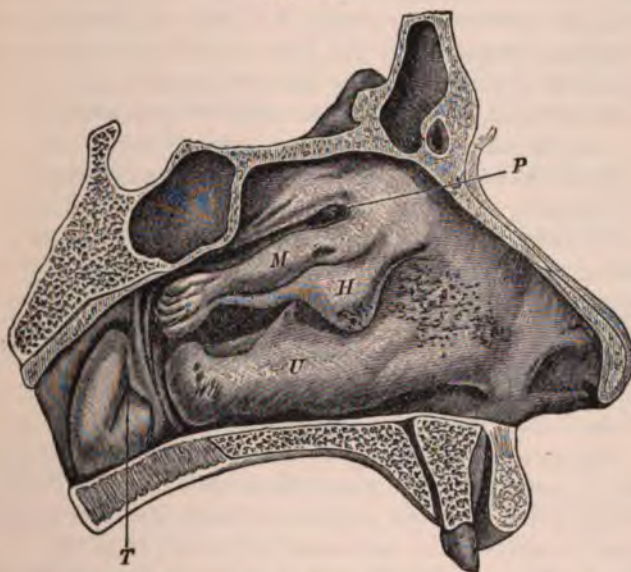
forming a prominent and striking object of a dark bluish-red or whitish-gray color. The posterior end of the middle turbinal is sometimes also enlarged, and seen as a nodular tumor of polypoid appearance, of a pale, translucent, yellowish-pink color. The enlargements on the posterior portions of the septum appear as smooth, usually light gray prominences, commonly on each side of the vomer; this may give to the rear end of the septum a spindle-shaped form. After inspecting the nasal surface a cocaine spray of four per cent. strength is to be applied to the mucous surface and the nasal fossæ again inspected. Whatever portion of the swelling is due to mere intumescence will usually retract under the influence of the cocaine, and the swelling that remains is in most cases due to true hypertrophy. This, however, is not always the case, as under the stimulus of the cauterizing parts contract down to the bone which will not do so for cocaine. Cocaine is therefore not an absolute means of diagnosis between intumescent and hypertrophic rhinitis. In some cases one

finds that not only the mucous surface but the turbinated bones themselves have enlarged as a result of hypertrophic rhinitis.

Hypertrophy of the middle turbinals is found less frequently than that of the inferior, but it is not a rare condition. The anterior portion is the favorite seat of enlargements, and the smooth, translucent, often nodular, masses, of pale-pinkish hue, can be seen to press against the septum, closing the olfactory fissure and causing anosmia and neuralgic pains in the forehead and eyes. It is especially the lower border of the middle turbinal that is found enlarged.

Diagnosis.—The diseases to be distinguished from hypertrophic rhinitis are intumescent rhinitis, syphilis of the nose, and nasal mucous

FIG. 113.



Left nasal fossa. (Bresgen.) *H*, polypoid thickening of anterior end of middle turbinal (*M*); the latter and the lower turbinal (*U*) present marked hypertrophy of the mucosa of the posterior ends; *T*, orifice of Eustachian tube; *P*, polypus in the superior meatus.

polypi. The readiness with which the probe will displace the swelling and press against the bone in intumescent rhinitis and the usual subsidence of the tumefaction under cocaine are the main points in diagnosis. In hypertrophic rhinitis the tissues give an impression of solidity when pressed upon, and their surface is irregular and uneven, while it is smooth in intumescent rhinitis. Diffuse gummatous infiltration of the nasal mucous membrane without ulceration may be hard to distinguish from hypertrophies of a non-syphilitic nature, and one must often await the results of specific treatment for purposes of diagnosis. Nasal mucous polypi hardly ever originate from the lower turbinal. As there is a histo-

logical unity between the polypoid hypertrophies of the middle turbinal and true mucous polypi, and as the latter often result from these hypertrophies, it is often hard to tell where the polypoid degeneration of hypertrophic rhinitis ends and the true polypus begins. The enlarged posterior end of the lower turbinal has some resemblance to a polypus, but it has a rougher surface, and is usually bluish-red or white, while the polypus can be seen resting on the soft palate as a glassy, oyster-like, smooth gray tumor, generally large enough to hide the whole of one choana from view.

Prognosis.—If left to itself, hypertrophic rhinitis seldom shows any tendency to spontaneous recovery, excepting after months or years. This may occur in favorable cases, the hyperplasia receding until the affected parts resume their normal appearance or atrophy occur. In many cases the hypertrophy gradually increases, and when its maximum is reached remains unchanged indefinitely. It is certain that in a considerable number of cases shrinkage of the affected mucous membrane and turbinated bones sets in, and continues until atrophic rhinitis with *ozæna* develops. In one case this process was seen to run its course in eighteen months. Moritz Schmidt has seen atrophy and hypertrophy coexist on the same turbinal, and thinks it logical to suppose that, as in other mucous membranes, the hypertrophic process has advanced in some portions to atrophy, while in others it is still in the hypertrophic stage.

Sinus disease, fortunately, only in rare cases results from hypertrophic rhinitis, and when it does it may lead to meningitis or sepsis. When treatment is patiently pursued in hypertrophic rhinitis by both patient and physician the prognosis becomes favorable both as to the disease and its usual complications. The discharge disappears, the headaches cease, and the voice becomes normal, but the sense of smell does not always return and the secondary changes in the middle ear may be irremediable. The so-called reflex neuroses will often disappoint the surgeon by persisting after the rhinitis has been removed.

Treatment.—The treatment of hypertrophic rhinitis is chiefly surgical, with general and local treatment as adjuvants. In reduction by chemical measures, monochloracetic, trichloracetic, and chromic acids are the ones most to be recommended. Of these chromic acid is the most efficient, but the other two are less liable to cause adhesions. Reduction of hypertrophic swellings by chemical means, however, is not to be recommended, as other measures are so much more rapid and efficient. Of these the cold snare is to be preferred when it can be employed, as it removes the hypertrophic masses bodily and the reaction after its use is very slight, while relapses of the hypertrophic condition do not occur with the same frequency as after the galvano-cautery. After taking away as much redundancy of tissue as one can with the snare, it is often needful to complete the treatment with the galvano-cautery.

In hypertrophic rhinitis the swellings are ordinarily not purely hyperplastic, but are partly due to dilatation of the vessels of the mucous membrane. Cocaine contracts these and so diminishes the volume of the tissues that the snare may glide from them; therefore it is well to apply the latter gently, but with enough constriction to get a firm hold before applying the cocaine. Many patients will submit to the operation without cocaine if the snare be tightened slowly and intermittently, the constriction ceasing as soon as the patient winces from pain and beginning again when the pressure has benumbed the tissues. Another advantage of importance is that slow tightening of the snare makes the operation almost bloodless, while rapid resection of the tissues causes free hemorrhage. Nevertheless, after removal of portions of the lower turbinal with the snare it is well to pack the nasal fossa with lint powdered with bismuth or iodol and boric acid, as, if it be left unpacked, bleeding may commence some time after the operation when the patient is out of the surgeon's reach. The packing may be removed after the second day; its method of application will be described under operations for deformities of the septum.

When the snare cannot be made to take hold of the tissues of the anterior parts of the turbinals, a needle may be thrust through the mucous membrane and the snare applied over this, but ordinarily such cases are better treated with the galvano-cautery. Hypertrophies of the anterior end of the middle turbinal are favorable objects to catch in the wire loop, and usually there is but little difficulty in removing them to the bone with this implement. Those of the posterior end of the middle turbinal are the most difficult of access of all the hypertrophies. When the wire loop cannot be applied, some variety of cutting forceps may be used. Very often there is not room to seize much with the forceps, and in these cases a small ring-knife on a slender stem or the instrument called the spokeshave is more effective than the forceps. The spokeshave blade best suited to the work is pear-shaped. These ring-knife blades scrape off the polypoid hypertrophies piecemeal.

The hypertrophied posterior end of the lower turbinal is, as a rule, not difficult to engage in the wire loop. A loop of suitable size is to be bent at right angles to the snare-tube, and withdrawn a little within this to facilitate introduction within the nose. The loop should be passed along the lower meatus, and as soon as it has entered the nasopharynx it should be pushed out of the tube again to the proper distance, and so held that it will spring outward towards the lateral pharyngeal wall. It

FIG. 114.



Ingals's nasal scissors (one-third natural size).

should then be pressed upward and outward and drawn forward until it can be felt to lightly engage the swollen end of the turbinal. Then the end of the tube must be firmly pressed into the tissues and the snare tightened. Sometimes passing the finger into the nasopharynx is of use in applying the loop. When the use of the snare is impossible, it is best to cauterize the tissues of the lower turbinal with the galvano-cautery, but the results are not so certain as in intumescent rhinitis. The most efficient method of cauterization is that described under intumescent rhinitis, where it is shown that two or three linear incisions are usually

FIG. 115.



Nasal trephines (actual size). Modification of Curtis.

sufficient to reduce the hypertrophy. The lower turbinal must be cauterized along its whole length; therefore it is well to measure the depth of the nasal fossa as far as the posterior end of the lower turbinated body, in order to be sure to include this in the cauterization. This measurement can be performed in the manner described in the article on intumescent rhinitis, or perhaps the end of the electrode can be seen by posterior rhinoscopy. If the electrode be passed too far back it may burn the Eustachian orifice, an accident apt to be followed by pain and possibly otitis media.

Enlargement of the turbinated bones themselves requires their resection. Ordinarily it is the lower turbinal that is involved, and the free edge or more of it can be taken off with the saw or strong nasal

FIG. 116.



Nasal burrs (actual size).

scissors. A better method is that of drilling out a core from the bone with the dental burr or trephine. These instruments, attached to the electric motor dental engine, are run beneath the mucous membrane, enough of the bone being removed to allow the soft tissue to contract until sufficient space be obtained. When it is not possible to remove the redundant tissue from the middle turbinal, cauterizations may be indicated. A small loop-like or pointed electrode may be used with advantage, and is to be thrust into the lower edge of the turbinal in three or four places. D. B. Kyle, in operating on the lower turbinal,

makes two oblique linear cuts with a special knife, so as to remove a long prism-shaped piece, the apex of which is attached to the bone, while the base corresponds to the free surface of the turbinated body. This is finally separated from the bone by the snare or saw-scissors. Even if the hemorrhage in this operation be not of serious consequence to the patient, it will at least so obscure the field of vision that the accurate performance of the second incision will be doubtful.

Electrolysis effectually reduces the redundant tissue, and is followed by so little local reaction that the absence of consecutive inflammation is one of its chief advantages. It is performed by means of the bipolar electrode, consisting of two needles made of steel, platinum, or iridio-platinum. The positive needle, if of steel, is attacked and roughened by the current, and platinum is so soft that it bends too readily, so that iridio-platinum is to be preferred. The current to be used should measure from twenty to forty milliamperes, twenty milliamperes being the usual limit of endurance, as, in spite of cocaine, the process is painful. A rheostat, preferably of graphite, is a necessity, as all sudden changes in the current must be avoided because they are painfully startling. The current should start at nothing, be slowly increased to the ampèreage mentioned, and reduced as gradually, a sitting of six minutes being sufficient. The chief objection to electrolysis is the slowness with which results are gained; its advantage is the absence of inflammatory reaction and consecutive adhesions. If adhesions follow the other methods of operation, electrolysis is the best means for their removal, as the destruction caused by its use is not followed by the exuberant granulations often seen after operations with the saw-scissors or caustics, in which granulations speedily renew the adhesion previously destroyed. A battery of at least twenty-four cells is needed to furnish a current of sufficient voltage to overcome the resistance of the tissues and give the required current of twenty milliamperes, the number of volts required being from forty to eighty. Graphite rheostats can now be obtained which will reduce a direct galvanic current of one hundred and ten volts—the current usual for incandescent lamps—to nothing, if desired. It is necessary to have a sixteen-candle-power lamp in series with the rheostat to keep it from getting hot. A rheostat of this kind obviates the need of a battery, but the alternating current cannot be used for electrolysis. The needles are to be thrust into the tissues for their whole length, and before their introduction the strength of current is to be tested by connecting them by a pledget of wet cotton, while the amount of current is measured with the milliamperemeter, and should be twenty milliamperes. The action of the galvanic current causes a white foam to appear about the needles, the slough created being more noticeable after a few days. After its separation the tissues look as if a piece had been cleanly bitten out of them. The hypertrophies on the septum can be removed with cutting forceps or reduced by the galvano-

cautery, but electrolysis can also be used here with success. The surgeon can locate the position of the needles at the back of the septum by posterior rhinoscopy.

The galvano-cautery snare is used by some operators for removal of hypertrophies of the turbinals. The advantage it offers is lack of bleeding, an advantage more than offset by the greater difficulty of manipulation of the snare by reason of the heavy attached cords. Another objection to the hot snare is the inflammatory reaction which follows its use, while there is but little after operations with the cold snare.

Metallic, gutta-percha, or soft-rubber tubes, sponge and laminaria tents have all been recommended for the treatment of hypertrophic rhinitis by pressure, but may be regarded as practically obsolete.

Care is to be taken not to make the nasal fossæ too roomy by operative measures, lest one produce conditions similar to those of atrophic rhinitis, with nasal passages so large that the air is not moistened enough by the diminished mucous surface, and the secretions dry and accumulate. On the other hand, timid treatment will produce but partial and temporary relief; hence the patient who has been given an atomizer wherewith to blow away his mucous hypertrophies is, unfortunately, common. Fear of hemorrhage is the chief deterrent from operative measures, but this can be controlled by packing the nares with strips of lint saturated with bismuth subnitrate or iodol and boracic acid powder. If properly done, this will absolutely control bleeding, while, owing to the powder, the plug will remain odorless and aseptic for a week, though, as a rule, it need not be retained more than two days. Therefore, fear of bleeding need not deter one from the use of the snare, scissors, or other cutting instruments. The method of packing the nasal cavity is described under epistaxis.

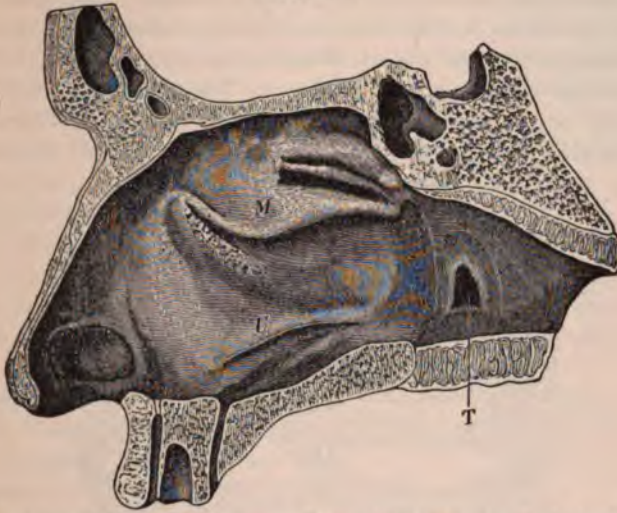
ATROPHIC RHINITIS.

In atrophic rhinitis the mucous membrane, as well as the bony framework of the nasal cavity, atrophies. These changes are most marked on the turbinals, which shrink away, leaving the nasal fossæ abnormally roomy, while at the same time an extensive epithelial metaplasia from ciliated to pavement epithelium makes possible the adhesion to the mucous surface of dried secretions in the form of crusts. In the majority of cases these emit an offensive odor, producing a condition called ozæna. The nasal bones may be normal, but in many cases are shortened in all directions, so that the nasal bridge sinks in, making the flat, pug, or saddle nose often characteristic of the disease. The mucous surface may remain comparatively intact, while the bone shows the greater atrophy. The septum also diminishes in size, growing shorter from before backward, as the investigations of Hopmann have shown.

If the crusts be lifted off, their under surfaces are found moist or cov-

ered with fluid pus. The offensive odor of ozæna clings to these crusts, and usually disappears with their removal. The crusts may be discrete or

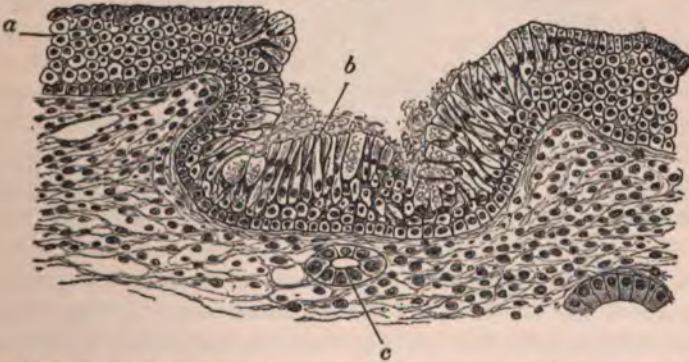
FIG. 117.



Right nasal fossa. Atrophy of mucous membrane and turbinated bones. (Zuckerkandl.) *M*, middle turbinal; *U*, lower turbinal; *T*, Eustachian tube.

line the entire nasal cavity like a cast. The mucous membrane is pale, neither eroded nor ulcerated, and in advanced cases is firmly attached to the bony surface like a thin serous membrane. Extreme atrophy of the turbinals makes possible direct inspection of the nasopharynx and Eu-

FIG. 118.

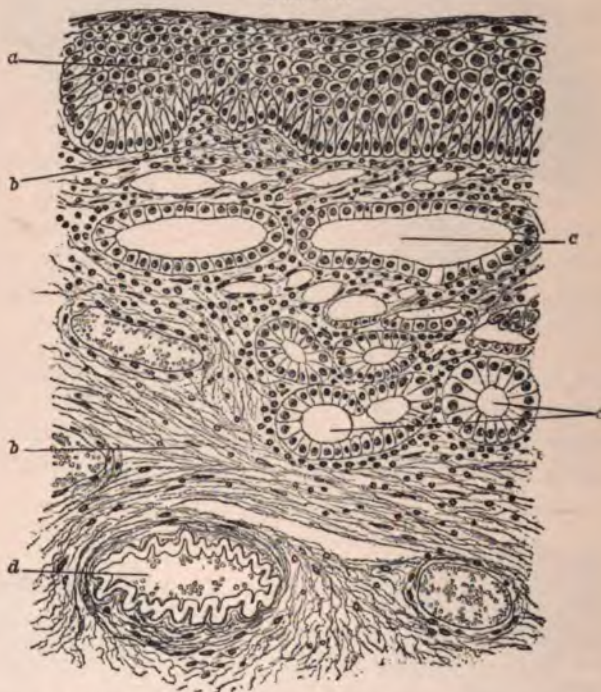


Metaplasia of cylindrical epithelium of nasal mucosa to pavement epithelium. (Stoerk.) *a*, epidermis-like change of epithelium; *b*, preserved cylindrical epithelium in a state of secretion; *c*, mucous gland.

stachian orifice, the infundibulum with the openings of the accessory sinuses, and the orifice of the sphenoidal sinus.

Microscopically, there are found in the less advanced cases areas of pavement epithelium where normally the ciliated kind should be found. Early in the disease the submucous tissues present the round-celled infiltration usual to chronic inflammatory processes; later these organize into cicatricial tissue. The mucous glands become obliterated, suffer ampullar enlargement in places, diminish in number, and the muscular elements of the erectile tissue atrophy. The specialized epithelium of the olfactory region also suffers metaplasia, so that in most cases of atrophic rhinitis the sense of smell is lost. Fränkel found that the

FIG. 119.



Section of entire thickness of mucous membrane in atrophic rhinitis. (Stoerk.) *a*, pavement epithelium; *b*, *b*, connective tissue moderately rich in cells; *c*, *c*, glands largely degenerated; *d*, blood-vessel with excessively enlarged wall.

fresh secretion obtained just after cleansing contained but few micro-organisms and had no fotor, but that removed after six hours was putrid and loaded with bacteria. Abel, Paulsen, and other observers found among these a bacillus constantly present on the mucous surface, which is called the bacillus capsulatus mucosus, and to which they attributed the disease.

Etiology.—The question of the etiology of atrophic rhinitis is at present the subject of controversy. The usual opinion is that atrophic rhinitis

is the last stage of the hypertrophic variety. This is the view of the majority of observers. In reviewing all the opinions of the etiology of ozæna, it is shown that this disease can originate in several ways, and that it is probably the final stage of more than one morbid process. In some cases the affection is the result of hypertrophic rhinitis, while sinus disease will certainly account for far more cases of atrophic rhinitis than has been supposed, and should be looked for with more diligence than heretofore in every case of ozæna.

Symptoms.—The general health of the patient may be unimpaired; indeed, it is remarkable how little it suffers from the disease. The headaches and irritative symptoms of the other forms of rhinitis hardly disturb the sufferer from ozæna, the atrophic mucous surface not being sensitive. When sinus disease exists as a complication or cause, distressing neuralgias and headaches often accompany this condition. What causes the greatest distress to the patient is the fact that he is an object of disgust to others on account of the stench emitted from his nostrils. The foul smell of ozæna may be so great as to fill a room; in other cases one must approach the patient closely to notice it. He ordinarily has no perception of the odor, as his olfactory sense is blunted or destroyed by the atrophy of the olfactory nerve-ends. There are cases of atrophic rhinitis unaccompanied by any odor. Breathing through the nose is generally unobstructed unless pus and crusts block up the nares. In most cases there is no discharge from the nostrils, the secretions being blown from the nose or hawked back into the pharynx every few days, in solid form, in the shape of offensive crusts. If large and hard, these may come away with difficulty, causing nose-bleed at times, or, if delivered by the nasopharynx, they may create retching and vomiting. Their presence in the nose, if of sufficient size and consistency to cause pressure, will result in pain in the nose and forehead till they are removed. The secretion does not always consist of dry scabs, but may be semifluid adherent pus or soft purulent coagula.

Inspection.—The secretions generally do not cover the mucous surface entirely, but lie on it in areas of varying size and consistency, from large, hard, yellow or gray scabs which cover an entire turbinal or side of the septum to pasty patches of sticky pus. When they are removed, all degrees of atrophy of the turbinals and mucous membrane are found, at times coexisting with regions of hypertrophy. Atrophic rhinitis may

FIG. 120.



Bacillus of ozæna. (M. Schmidt.)

even be confined to one side of the nose, and here the possibility of sinus disease as a cause is very great. In well-marked cases of atrophic rhinitis the turbinals have shrunk to mere ridges, and the nasopharynx, Eustachian orifices, and motions of the soft palate are plainly visible. Fortunately, the outlets of the accessory sinuses also become abnormally exposed by the disease process, so that in some cases the openings of the sphenoidal sinus, ethmoidal cells, and the orifice of the frontal sinus in the infundibulum become visible and in all are more easily reached with a probe than in health. This is of value in considering the possibility of sinus disease as a cause of atrophic rhinitis. The atrophy of the mucous membrane does not always keep pace with that of the bones. Especially in the upper part of the nose, portions of the mucosa may hang down in swollen, congested, reddened folds, irritated by constant contact with pus and bleeding readily when touched, while the atrophied turbinated bone no longer gives support, so that these pendulous masses of mucous membrane are freely movable. The disease process rarely stops in the nares, and involvement of the nasopharynx and, unfortunately, of the middle ear is very common. The latter complication creates, as a rule, intractable middle-ear sclerosis, while otitis media suppurativa is rare. In some cases the disease process extends to the larynx and far down the trachea, both being lined with dry patches of secretion, while the swollen and reddened laryngeal mucous membrane is covered with adherent pus, the voice failing greatly in these cases. The vault and often the lateral walls of the nasopharynx are frequently the seat of accumulations of dry scabs or of semifluid pus.

Diagnosis.—Syphilis of the nose is the condition most likely to be mistaken for ozæna, especially when the former has led to wide-spread destruction of the turbinals with subsequent cicatrization. Here, as in ozæna, may occur cell-metaplasia and crusting, but the defects in the bony septum almost always left by the disease enable one to make a diagnosis, even if there be no longer any dead bone present. In cases of nasal syphilis in which the disease is still active, necrotic bone and ulceration differentiate from atrophic rhinitis.

Simple recent suppuration of the antrum or frontal sinuses presents a picture quite different from that of atrophic rhinitis. The appearance of pus flowing in the middle meatus, usually on one side only, its obstinate reappearance when wiped away, and the freedom of the rest of the nasal cavity from disease serve, with the other symptoms of suppuration of the antrum or frontal sinus, to differentiate this state from ozæna. The pus also, though of a foul odor, does not produce the stinking breath of atrophic rhinitis, and its smell is generally noticed by the patient himself, while in atrophic rhinitis the sense of smell is usually lost.

Chronic suppuration of the ethmoidal cells or sphenoidal sinuses, on the other hand, presents a picture so like that of ozæna that extremists

have maintained that all cases of atrophic rhinitis are due to it. Only the most painstaking exploration of the sinuses can distinguish this disease, and doubtless the increased attention to sinus examination that Grünwald has incited will greatly diminish the number of cases diagnosed as simple ozæna and add much to the list of cases of sphenoidal and ethmoidal disease. There is usually no difficulty in distinguishing atrophic rhinitis from lupus, because of the external manifestations of the latter disease.

Prognosis.—If left to itself, atrophic rhinitis continues for many years, but it seldom causes much inconvenience in those over thirty-five. Though in some cases the atrophied tissues have been regenerated and restored to their normal conditions, the rule is that the atrophy is irremediable. The deafness is also incapable of improvement and the anosmia remains permanent. In regard to the symptoms of fetor and crusting, however, the prognosis is good, as both these conditions can speedily be relieved, though generally not permanently unless treatment be persisted in for a year or two. The cases depending on sinus disease will not recover until the offending ethmoidal cells or sphenoidal sinus have been opened and curetted thoroughly, after which speedy relief may be expected.

Treatment.—There are four things to be accomplished in the treatment of atrophic rhinitis: removal of all secretion, disinfection of the mucous surface, covering this in the interval between washings with antiseptic powders, and stimulation of the circulation of the parts.

The first object—cleaning of the nares—is best accomplished by the hard-rubber irrigating tube mentioned under treatment of acute rhinitis and simple chronic rhinitis. Syringing the nose, the nasal douche, and snuffing water up from the palm of the hand all include the danger of fluids penetrating the middle ear on account of the great quantity entering the nasopharynx at one time. Freer's small hard-rubber tube can be moved freely back and forth and furnishes enough fluid to cleanse without flooding the nares, while the force of the minute streams is sufficient to dislodge the secretion. If there be dry crusts, it is necessary, in order to soften them, to have the patient coat them with vaseline or fluid vaseline by means of a small, long-handled, soft brush or a common sewing-machine oil-can. This should be done some hours before washing the nares, when the softened masses will readily come away. The physician is to teach the patient to use the tube, to pass it back into the nasopharynx and to move it about so as to direct the streams to the places in which secretion habitually lodges. The best solution for disinfection is potassium permanganate, from one-twenty-fourth to one-eighth of a grain to the ounce of warm water. It is not necessary that the physician should personally wash the patient's nasal cavity, but he should keep watch of its condition and see the case at least twice a week at first and later once in from two to four weeks. If atomizers were not so often

prescribed to remove the secretions of atrophic rhinitis, it would hardly seem necessary to say that the tough, pasty masses and dry scabs cannot be removed with a spray.

The third and fourth indications—the coating of the mucous surface with antiseptic powders, and its stimulation—are best considered together. Often in the milder cases the cleansing and disinfecting treatment is all that is needed; in the more obstinate ones the insufflations of iodol in powder, either pure or combined with mercuric bichloride, myrrh, benzoin, berberine, boric acid, or aristol, with sugar of milk as a base, are excellent applications.

Powders are used when there is free secretion, and sometimes, even though there be much dryness of the part, they have a most satisfactory effect, especially if associated with the oleaginous sprays of carbolic acid, menthol, oil of cloves, or other similar substances, in oleum petrolatum album; the rule being that whatever application is made should not cause the patient discomfort for more than five or ten minutes. The powders and sprays are best used in the following strength, to be applied by the patient two or three times daily: mercuric bichloride, from one-tenth to one-fifth of one per cent.; iodol, twenty-five per cent.; boric acid, ten per cent.; aristol, from five to eight per cent.; benzoin or myrrh, twenty per cent.; berberine muriate, ten per cent. The sprays contain: menthol, from one-tenth to one-fifth of one per cent.; carbolic acid or iodine, one-fifth of one per cent.; oil of cloves, from one-half to one per cent. Similar applications should be made by the physician sufficiently strong to cause discomfort for half an hour.

An excellent aid to treatment is the tampon of Gottstein. Whenever cotton is in direct contact with the mucous surface it excites enough

secretion to soften and remove crusts, so that if a patient be not in a position to irrigate his nasal cavity, he can keep it clean and free

FIG. 121.



Screw applicator for Gottstein's tampon.

from fetor with the Gottstein tampon. It involves the objection that one naris must be partly or wholly closed, but, as the nasal fossæ are abnormally roomy in atrophic rhinitis, this is of no great moment. The cotton is placed in the nasal cavity with a screw applicator having a coarse thread. This is pushed upward and backward into the nose, and kept turning to the right until the cotton has entered the nostrils, when the motion is reversed and the applicator unscrews itself from the cotton, which is left lying in the nasal cavity. In an hour or two this can be blown out with the softened secretions. Robert Krieg uses no applicator, but has the cotton wound into a stiff cylinder of cigar shape and smeared with white precipitate ointment and vaseline, equal parts. This is then worked by the patient into the nostrils with a screw mo-

tion, and should be as long as the index-finger and thick enough to apply itself to the wall of the naris. It is to be worn four hours in one, then four hours in the other nostril, and never at night. Krieg has seen recoveries, so far as fetor and dried secretions were concerned, in the course of a year or two when this method was persisted in, no irrigations being employed.

Copper electrolysis is a method highly recommended in the treatment of atrophic rhinitis, and Moritz Schmidt thinks that the speedy recoveries which he has seen from its use prove that ozæna is in most cases not a mere sequela of sinus disease. It is a method originated by Gautier and Jouslain, and its beneficial effect is supposed to be due to the creation of oxychloride of copper at the acid pole. The positive pole is therefore the efficient one, and it can be used alone, a copper needle being thrust into the lower border of the inferior turbinal or other diseased portion, while a current of from three to fifteen milliamperes is used for about ten minutes, the negative pole being represented by a sponge held against the cheek or back of the hand. In the bipolar method a steel needle is inserted into the lower turbinal, while a copper needle is introduced into the middle one, the current strength being the same as mentioned above. The bipolar method is preferred by most, and a platinum needle may be used instead of a steel one. This permits of reversal of the current in order to make the copper needle come out without hemorrhage, as the acid coagula about the positive pole make it hard to withdraw the copper needle, roughened as it is by acid action, until reversing the current has made it the alkaline pole. The platinum needle is of course not corroded by being made the positive pole, as a steel one would be. Étievant sometimes places the negative needle in the opposite nasal fossa, and states that one has to place the needles in various positions, according to the case. He uses strong, stiff needles, ten centimetres in length, insulated by small rubber tubing. In reversing the current it must be reduced by the rheostat to zero, the poles changed, and the current again increased to fifteen milliamperes for two minutes, then reduced again to zero, so that the copper needle will withdraw without a shock, the latter being painful and terrifying. The worst result of the operation so far recorded has been meningitis due to perforation of the cribriform plate by the needle. A vertical direction of the needle and incredible ignorance of nasal anatomy account for this event. Pain is often felt in the superior dental nerves during the operation, vertigo and syncope have occurred in nervous patients, and orbital neuralgia has followed the operation for some hours, but, on the whole, the method may be considered safe and efficient and followed by but trifling reaction. McBride, of Edinburgh, reports eight cases,—four recoveries which were still free from secretion and odor after eighteen months, and four that improved. McBride says that copper electrolysis "is one of the most valuable therapeutic resources suggested for ozæna."

It does away with the need of the endless washings so tiresome to the patient. The permanency of the results, however, is not yet sure.

Injections of diphtheria antitoxin have been used in the treatment of atrophic rhinitis, with undoubted but only temporary benefit. Before adopting any method of treatment the surgeon must look for sinus disease.

In conclusion, vibration-massage is to be mentioned,—a method that has produced some very successful results, the regeneration of the mucosa following its use even resulting at times in partial hypertrophy. The end of a stiff, large probe is covered with absorbent cotton, and this is dipped in a ten per cent. ointment of euophen in lanolin and rubbed rapidly over the mucous surface in a vibratory manner for two minutes daily. The postnasal space is treated in the same way from in front, or by passing the probe up behind the palate. As the vibratory motion is very tiring to the arm, electric implements for vibration-massage, designed for attachment to the dental engine, are often used.

CHAPTER X.

NASAL TUMORS.

NASAL MUCOUS POLYPI.

Synonyme.—Nasal myxomata.

NASAL MUCOUS POLYPI are not myxomata, but outgrowths from the connective tissue of the nasal mucous surface, and hence are to be considered fibromata. They occur often in great numbers in the nasal fossæ, and are apt to block these completely. They are either pedunculated or sessile, and in most cases give rise to a free mucous discharge.

Etiology.—It is probable that nasal mucous polypi are the result of chronic rhinitis, and represent a hyperplasia in a state of œdema. All observers do not, however, agree with this view, notably Barbier, of Lyons. Paul Heymann is of the opinion that, as the result of irritations, the mucous surface loses its normal smoothness, develops papillæ, and that some of these undergo œdematous hyperplasia, gradually becoming nasal mucous polypi, whose growth is favored by gravity and œdema due to obstructed return circulation through their stems.

Polypi have been found in people of all ages, and may even be congenital; they are, however, rare in childhood and old age. They are commonest between the ages of twenty-five and fifty. An hereditary predisposition doubtless exists in some cases.

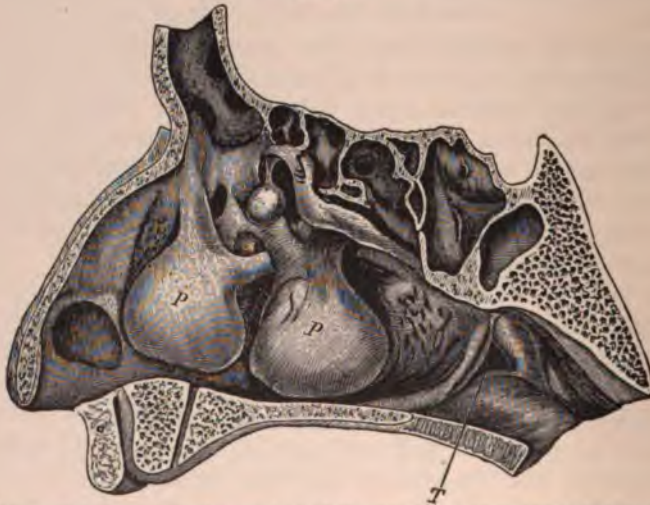
Pathology.—The typical mucous polypus is attached to its base by a slender neck or peduncle, and is of varying shape, though usually pyriform or globular, and the average specimen varies in size from that of a pea to that of a walnut. Its consistency and color resemble those of an oyster, and it possesses a jelly-like translucence and a smooth and glistening surface. Often fine blood-vessels are seen entering the peduncle and spreading in delicate branches over the surface of the growth, but the variations from this type are many. The polypus may be firm and opaque as connective tissue predominates in its structure, or it may be quite red if blood-vessels form a large part of its substance. When the epithelium is much exposed to the air or to irritation, as when the growths are located in the nasal vestibule or nasopharynx, it becomes like epidermis and covers the surface with a white, opaque coating. In size polypi vary from microscopic dimensions to enormous growths which force aside the nasal bones and bony framework of the inner nose and appear externally or extend down to the larynx. Such growths may be four or five inches in length and correspondingly bulky.

Polypi may have several lobes, and their attachment may be broad, so that they form sessile tumors. The shape of the larger ones is much influenced by the nasal passages in which they grow, so that they may be long and flattened or branched to fit into the meatuses or into one another. Those found in the nasopharynx assume a globular or pyriform shape. Polypi may be very numerous, but generally not more than from six to ten are found in one nasal fossa.

The source of origin is oftenest the lower border of the middle turbinal and middle meatus, but they may grow from any part of the mucous surface, even the septum, the lower turbinal, and the nasal floor, though polypi in these last-named locations are very rare and usually single.

The ethmoid region forms the territory on which mucous polypi

FIG. 122.



Right nasal fossa. (Bresgen.) Two large polypi (P P) with more than one attachment; T, Eustachian tube.

flourish, so that the middle turbinal, middle meatus, upper turbinal, and upper meatus are the chief places of origin of these growths. They are also found attached to the edges of the hiatus semilunaris, or growing from the openings of the accessory sinuses, or originating even from within the antrum of Highmore and the ethmoid cells.

Nasal mucous polypi are connective-tissue growths. In the typical soft polypus this forms a delicate reticulum of fibres resembling embryonal connective tissue, the reticulum consisting of a coarser net-work of fibres enclosing a finer one. The outer surface of the nasal mucous polypus is covered with ciliated epithelium and a basement membrane like the rest of the mucous lining or the nasal fossæ. In places the

epithelium may change to the pavement variety. Nerve-fibres have been demonstrated in these growths.

Symptoms.—Nasal mucous polypi may cause no symptoms so long as they are small. When larger they give rise to mechanical irritation and corresponding discharge of a serous or purulent nature from the nasal mucous membrane. The purulent secretion stimulates the mucous surface to the production of more polypi, and, in fact, the discharge from sinus disease or other nasal suppuration may originate the growths. As these get larger they are often felt by the patient moving back and forth as a foreign body, and soon begin to occlude the nares more or less completely.

The olfactory region may be early shut off from the air-current, so that anosmia may exist long before nasal occlusion. In some roomy nasal fossæ this latter symptom may remain moderate.

FIG. 123.



Section of polypus. (Heymann.) The areolar tissue is especially well shown. The epithelium is ciliated to the left; to the right it shows change to pavement epithelium. Enlargement, 1×20 .

Pressure on the Eustachian orifice or the aspiration of air from the middle ear, due to complete nasal occlusion, stops the ventilation of the middle ear, and deafness is a frequent symptom. If originating from the lower turbinal, a growth may close the tear-duct. A sense of pressure and fulness in the nose is often felt by the patient, and neuralgic pains radiating into the various branches of the first and second divisions of the fifth cranial nerves are common symptoms. Reflex asthma is frequently caused by polypi, and nightmare, headache, giddiness, epilepsy, congestion of the fauces, hay fever, and other reflex disturbances sometimes result from the presence of these growths, but these conditions usually have no connection with nasal mucous polypi. Vascular polypi may give rise to obstinate and severe epistaxis. Damp weather causes nasal mucous polypi to swell because of their hygroscopic qualities, so

ority of other methods, hardly worthy of mention. Some surgeons still clear the nose of the growths with the polypus forceps. This barbarous method is an historical survival, and only to be accounted for by the fact that many do not master the simple technique of rhinoscopy. The operation is performed without the aid of a mirror, the forceps being guided by the hand without the help of the sense of sight, so that great damage has been done to the nasal interior, whole turbinals having been torn away and the septum fractured, while the slippery polypi have to a great extent eluded the grasp of the blades, or have been removed only in part. The pain and bleeding caused by the method are extreme, and its consequences may be destruction of a large part of the physiologically important turbinals. A considerable number of cases of meningitis, as stated by Heymann, have followed the operation, even when performed by skilful surgeons.

The operation most in favor at present is the removal of the polypi with the cold snare. The galvano-caustic wire has its advocates, the

FIG. 125.



McIntosh cautery snare.

searing of the base by the caustic heat having a supposed influence in preventing recurrences. In some cases its use has led to erysipelas. In addition, the apparatus required is complicated, while the heavy cords and handle of the galvano-cautery impede the surgeon's movements.

As a preliminary to the operation with the cold snare or any other method, the parts are to be anæsthetized with a four per cent. solution of cocaine. This is to be applied as follows. A long, fine nozzle of silver is screwed to a hypodermic syringe. This is drawn full of the cocaine solution, that is forced through the syringe, drop by drop, after the end of the fine tube has been passed up to the source of origin of the polypi. This confines the anæsthesia largely to the parts on which the surgeon intends to operate, and reduces the amount of cocaine used to a minimum. The snare should be armed with No. 5 steel piano-wire. This must be fastened around the pegs on the side of the snare in such a way that

the wire crosses itself at each turn in a figure-of-8. This will prevent its becoming loose when under a strain. The tendency is to make the size of the loop too large, so that it becomes hard to manipulate in the nasal fossæ. The length of the loop must of course vary according to the size of the growth to be removed, but a good average is one inch. In addition to the snare, a pair of very small pliers is needed to straighten the loop after it has been used. The snare most to be recommended is a modification of an aural snare devised by Clarence J. Blake, called Ingals's snare. The loop should be introduced vertically along the septum, and between this and the polypus. As soon as it seems to be directly under the base of the growth it must be changed from a position perpendicular to the floor of the nose to one on the same plane; in other words, it must be passed in on its side and then turned so that it looks upward. In this position it must be so moved about with the aid of a slight backward and forward motion that it will slip up on the polypus. The snare must be moved upward on the polypus until it reaches as near to the origin of the growth as possible. As soon as the wire seems to be advanced as far up on the growth as it can go, it should be tightened by

FIG. 126.



Hypodermic syringe (half natural size). Long silver nozzle.

pulling on the sliding carriage of the snare. It is possible to tell whether the growth has been seized at its origin by moving the tightened loop back and forth. If the polypus has been caught at its base, the snare will seem fixed to a firm object; but if the surgeon has merely succeeded in seizing the polyp about its middle, it will seem as if the snare were fastened to a loose body. The loop must be tightened to a sufficient extent to take a firm hold on the growth, which must then be torn away. This not only insures tearing away the tumor itself, with its source of origin, but generally removes a number of small polypi which spring from the same base, and operators often succeed in evulsing in this manner a whole bunch of polypi as large as that originally seized. This method is preferable to the one of cutting through each polypus separately by means of the milled nut snare.

Sometimes the bunch of growths will not follow the snare after it has been cut off, but will lie in the nasal passages and have to be taken away with forceps or blown out by the patient. When one polypus or bunch of polypi has been removed, another one comes into view farther back in the nose; after this has been taken out, still another is seen, until at last the space is found clear of the growths back to the naso-

pharynx. Tumors which are attached near the posterior nares, or those lying behind septal spurs or deflections, are often exceedingly difficult to engage in the snare. To accomplish this the spur or deflection may have to be removed as a preliminary to the snaring of the polypus. Forceful blowing of the nose will often bring polypi which are seated far back in the nasal fossa into a situation where they can more readily be reached. When the growths lie on the soft palate in the nasopharynx, they can often be caught by passing the wire loop through the nostril, its adjustment being aided, if necessary, by the finger introduced into the nasopharynx. If the polypus cannot be induced to enter the loop in this way, the wire may be passed by means of a curved tube into the nasopharynx from behind the soft palate. This latter method is very difficult and tedious, however, so that it is preferable to pass a pair of nasal forceps through the nares to seize the polypus and drag it into the nasal fossa, where it can be encircled with the wire of the snare. If the growth be too large for this, it can be torn away from behind by means of the Löwenberg forceps. Very small polypi which are too small to catch with the snare are best removed with nasal forceps with cutting blades. For this Ingals's nasal bone-forceps is well adapted, or the little growths can be destroyed by the galvano-cautery. The latter is well adapted for

FIG. 127.



Cotton applicator (two-fifths natural size). Made of copper.

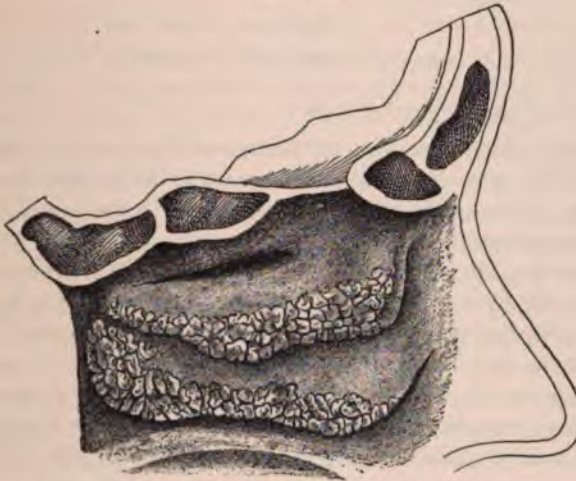
reaching areas of polypi in difficult situations, as, for instance, the posterior ends of the middle turbinals.

It is often not possible to clear a nasal fossa of polypi at one sitting, as the blood obscures the view and makes the attempts to snare the growths tedious and imperfect, so that by postponing their removal until another time the surgeon can operate with more speed and perfection. The bleeding during the operation is seldom great; but very little blood—even a few drops—will hide a polypus by obscuring its characteristic color. To wipe away the blood about fifty swabs of absorbent cotton mounted on applicators are needed during the operation. The application of adrenal extract before this will aid considerably in controlling the hemorrhage. Elderly patients with atheromatous arteries are liable to secondary hemorrhage, which may come on an hour or two after the operation. Removal of the angiomatous variety of polypi may be attended by such profuse bleeding that packing of the nasal fossa becomes necessary, especially if the growth has not been removed at its origin.

To eradicate the growths entirely it is necessary that the patient's nares be inspected at intervals of several weeks for a period of some

months. This will enable the surgeon to remove little tumors as they sprout until no more appear. Purulent nasal discharges and other sources of irritation suspected as causes of the disease must be removed, and sinus disease or carious bone as possible factors in the production of polypi must be remembered. After the polypi have been removed the patient should cleanse the nose once or twice daily with a wash of sodium bicarbonate, a teaspoonful to a pint of lukewarm water.

FIG. 128.



Papillary tumors of the nose on the middle and lower turbinals. (Heymann.)

Antisepsis and healing will be promoted by insufflation two or three times daily of a powder containing twenty per cent. of boric acid, fifty per cent. of iodol, and sugar of milk sufficient to complete the mixture, together with the use of a spray containing about one minim of oil of wintergreen, two minims of carbolic acid, and three minims of oil of cloves to an ounce of oleum petrolatum album. If secretion be profuse, ten minims of terebene may advantageously be added.

NASAL FIBROUS POLYPI.

Synonyme.—Fibromata of the nares.

These connective-tissue growths are closely related to mucous polypi. Their histological structure differs from that of the mucous polypus simply in the proportion of connective tissue composing their stroma. In the fibrous polypus this is composed of connective-tissue fibres densely crowded together, so that interstitial spaces hardly exist. Elastic fibres are found in good proportion, while blood-vessels are, as a rule, sparingly present. The epithelial covering is identical with that of the mucous polypus. These growths are rare, and spring from the

submucous connective tissue, or from the outer layer of the periosteum or perichondrium. They are commonly located in the posterior third of the nares, or the roof of the nasopharynx, or on the superior or middle turbinated body. They are very liable to become œdematous or the seat of inflammatory processes; they are harder than mucous polypi, and, as a rule, bleed more readily. They are to be removed by the same methods as those employed for the mucous polypi, with this difference, that their dense, tough structure makes the galvano-caustic snare preferable to the steel-wire loop.

NASAL PAPILLARY TUMORS.

Synonyme.—Papillomata of the nares.

The normal mucous surface of the nose contains no papillæ except in the nasal vestibule, and therefore is but little predisposed to the formation of papillomata, which are rarely found in the nasal fossæ, though they are more common than the fibromata.

Pathology.—Papillomata are usually found on the lower turbinal, but they are also found on the septum, the middle turbinal, and the nasal floor. Moritz Schmidt has seen them chiefly on the septum, just back of the nasal vestibule.

The surface of the growths presents varying appearances. If the papillæ be small, there is a resemblance to cutaneous warts; if they be large, the tumor acquires a shaggy look. Nasal papillomata may form pedunculated tumors, or exist as flat growths which spread over the surface. The consistency of the tumors varies from gelatinous softness to true warty hardness, the latter being the usual one. The largest growths seldom exceed a hazel-nut in size. They are generally small and solitary, but may extend over a large surface, as, for instance, the whole free border of a turbinal. Microscopically, these formations resemble laryngeal papillomata, and have thick pavement epithelium.

Symptoms.—The small size of these growths prevents them from creating much disturbance except occasional nose-bleed. They may be found accidentally, or cause obstruction to breathing, which leads to their discovery.

Diagnosis.—Growths resembling papillomata are found at the posterior end of the lower turbinal in hypertrophic rhinitis. The surface here is merely corrugated, not warty, and no true papillæ are found. Growths in the nose having the general appearance of papillomata, but possessing only a thin epithelial covering, are usually lipomatous or fibrous in character.

Prognosis.—Papillomata have a tendency to spread and to recur if removed.

Treatment.—The growth may be destroyed with nitric, acetic, or chromic acid, the cutting forceps or curette, or the galvano-cautery. In

one obstinate case all of these methods were tried unsuccessfully, as the warts repeatedly returned in from four to six weeks after each removal. Finally the patient was given a strong tincture of *thuja occidentalis*, which he applied to the part two or three times daily. This, with a few applications of chromic acid, finally eradicated the disease.

NASAL VASCULAR TUMORS.

Synonymes.—Bleeding polypus of the septum, angioma cavernosum nasi.

These growths are found principally on the anterior part of the septum, either low down near the nasal floor or higher up opposite the middle turbinal. They also occur on the lower turbinal, their size varying from that of a lentil to that of a tumor large enough to occlude the nasal passage entirely. Their surface is usually smooth, but may be granular, and their color is generally deep bluish red. The consistency of the growths is firmer than that of the mucous polypi, but their substance is very friable, so that firm pressure on a probe may cause it to enter the tumor. Nasal vascular tumors may have a broad base or be pedunculated. Microscopical examination shows the epithelial covering to be identical with that of the region from which the growth has sprung. The stroma consists of loose connective tissue surrounding the lumina of many large cavernous veins of irregular or oval shape, while arteries are sparingly present. These lacunar veins are found in greatest numbers in the deeper parts of the growth, and may form a large part of its substance. The etiology is unknown.

Symptoms.—The chief complaint of the patient is of frequent spontaneous nose-bleed, often of such severity that the loss of blood is alarming. Examination of the nares shows a tumor presenting an appearance much like that of a polypus; differing from it, however, in that it has a deep red color and an unusual seat on the septum or, rarely, on the lower turbinal. Touching it with a probe or seizing it with the forceps may start a hemorrhage that nothing but tamponing of the naris will quell. Cocaine has little effect on the bleeding or the size of the tumor.

Diagnosis.—The color and seat of the growth, together with the ready hemorrhage, will distinguish it from a mucous polypus, but not so readily from sarcoma, especially as the latter is often found on the septum, bleeds easily, and has at times a pedunculated shape. The microscope may be needed for diagnosis.

Treatment.—If pedunculated, the growths may be removed with the snare, though severe bleeding usually accompanies the operation. It is best to use the galvano-cautery snare and employ a red heat with slow constriction. If the growth cannot be caught with the loop of the snare, it may be destroyed with the galvano-cautery. Even here the bleeding is liable to be so great that the operation has to be interrupted and renewed

at intervals of about ten days, the growth being thus removed piecemeal, while the nasal fossa is kept plugged with lint to prevent return of hemorrhage. Nasal cutting forceps cannot be used unless the tumor be very small, as the bleeding after the first cut would make it impossible to continue the operation.

NASAL OSSEOUS CYSTS.

Etiology.—The presence of cavities in the anterior end of the middle turbinal is not infrequent, and is simply an anatomical abnormality, unless the bony walls of this cavity distend and form a cyst.

Pathology.—These bony cavities are generally seated in the anterior end of the middle turbinal, but have also been found back of this in the same bone or in the superior turbinal. They have a smooth globular shape, and vary in size from small cavities in the bony tissue, which cause no symptoms, to cysts that are as large as a hen's egg, and have been seen to protrude externally. Even if of moderate size, about that of a cherry, they crowd on the septum, forcing it into the other nostril, and in this way have in some instances produced entire occlusion of the opposite nasal fossa. The osseous cyst is also liable to press down the lower turbinal, and may reach the nasal floor. Exophthalmos has also been caused by pressure on the orbital wall. The osseous cyst represents an ethmoid cell that has been displaced into an unusually low situation. The outer covering of the growths may consist of thin, but normal, smooth mucous membrane covered usually with pavement epithelium, or mucous polypi may hide the bony cyst and grow from its surface. Its inner lining is also thin mucous membrane with ciliated epithelium. Polypi have been found within the cyst. The bony plate is delicate, and has a layer of periosteum on each side containing many osteoblasts. The contents of the cysts may be air, viscid fluid, or pus, as these cysts frequently suppurate.

Symptoms.—In addition to the nasal occlusion caused by the cyst, the pressure of so firm a body on the neighboring parts causes headaches of severity much greater than common. Intense facial neuralgia may occur. Migraine, vomiting, dyspnoea, partial loss of consciousness, and other marked nervous symptoms may be causes of complaint.

Inspection shows a smooth globular tumor, generally with normal thin mucous covering, pressing on the septum and perhaps forcing it more or less into the other naris. The tumor may reach such a size as to hide everything else from view. When opened it has been taken for the accidentally exposed cavity of the antrum.

Diagnosis.—This may present some difficulty when the tumor is hidden by polypi, and its firm structure also makes it liable to be mistaken for osteoma. Opening the tumor will make the diagnosis clear.

Prognosis.—The tumors are apt to grow to a large size, displacing important structures and causing great suffering.

Treatment.—Operation may be undertaken with the steel-wire loop, the galvano-cautery snare, or, if this cannot be applied, the growth may be taken away in pieces with nasal cutting forceps.

NASAL BONY TUMORS.

Synonyme.—Osteomata of the nose.

Pathology.—The shape of these tumors is ovoid or irregular, and depends much on that of the cavity in which they have originated, so that their surface may be smooth or lobulated.

There are two varieties of osteoma, the *eburnated* form, which has an ivory-like hardness, and the *spongy* or cancellous variety. Spongy osteomata have an outer compact shell of greater or less thickness. The hard variety may be so dense that it cannot be penetrated by cutting forceps or the nasal saw. Cancellous osteomata present the structure of cancellous bone with trabeculae radiating from the centre. The vascular supply of the growth varies, but even the ivory-like osteomata have many blood-vessels, while the spongy growths have a copious blood-supply.

The outer surface of the osteoma is covered with mucous membrane, often thinned by the distention due to increase of the tumor in size. Osteomata may be attached to their origin by a bony connection or mucous membrane and connective tissue forming a pedicle, or the tumor may have no connection with its surroundings. The base of origin varies and is not always easy to determine. The growths have been found originating from the ethmoid bone, the vomer, the lachrymal bone, the accessory sinuses, and other parts of the framework of the nasal cavity. The size of the neoplasm varies from that of a pea to that of a goose-egg. The tumors lie firmly wedged in by their surroundings even if they have no connection with them. Though of slow growth, they resistlessly push aside all normal structures in their way or destroy them by atrophy. In this manner the septum is forced over and the orbit, sinuses, and pharynx entered, while nasal occlusion finally becomes complete. When the osteoma originates from the ethmoid or lachrymal bone it soon forms a protrusion at the inner canthus. The tumors have been known to grow for from ten to twenty years before removal.

Symptoms.—At first these are slight, nothing being noticeable beyond itching, mucopurulent discharge and a tendency to nose-bleed. As the tumor grows the nose begins to feel full with a sense of weight, respiration is impeded, and the sense of smell is impaired. Added to these, pressure symptoms begin to appear, chief among which is pain, either of a dull, deep-seated character or occurring in sharp neuralgic attacks. Small tumors, if in the course of a nerve, may cause intense pain. Pressure on the lachrymal duct may produce epiphora with dacryocystitis and conjunctivitis, and exophthalmos may occur, which

may lead to blindness. Nasal mucous polypi frequently accompany osteomata.

Inspection shows the tumor to be covered with bright red mucous membrane that in some cases may present ulceration. This necrosis of the tumor and ulceration of the surrounding mucous membrane may lead to fetid discharge. The growth gives to the probe the sense of absolute hardness, while a needle cannot be made to enter.

Diagnosis.—Osteomata may be confounded with exostoses, rhinoliths, or malignant growths. At the outset they may be distinguished from exostoses by their movability, and later by their different form, larger size, and darker color. Rhinoliths may be distinguished by the absence of mucous covering, and by the ease with which their surface is broken or crumbled by a strong nasal probe or forceps. Malignant tumors grow much more rapidly, are usually very soft, and in all cases can easily be punctured by the needle. Like osteomata, they cause extreme pain and an offensive discharge.

Prognosis.—If the tumor be seen early enough, it may readily be removed through the natural passages, but, when large, external incisions are necessary and scars remain, unless it can be destroyed by a dental burr. There is no tendency to recur. If the growth be not arrested, it may lead to the gravest symptoms on account of pressure on neighboring structures of importance.

Treatment.—Bony nasal tumors often necessitate operations of a general surgical nature in order to gain sufficient room for their removal. Osteomata composed of spongy bone may be crushed with strong forceps or cut in pieces with nasal bone-forceps. This cannot be done to the harder tumors, which must be ground away with dental burrs or perforated with trephines driven by the dental engine. When a sufficient number of cores have been taken out in this way the bony mass may be broken with forceps.

NASAL CARTILAGINOUS TUMORS.

Synonyme.—Chondromata.

Pathology.—Chondromata occur more rarely in the nose than osteomata. Unlike the latter, their attachment is generally broad, and they are correspondingly immobile. They present a smooth, rounded surface, covered with reddened mucous membrane that is otherwise normal. In rare instances the tumors are surrounded by a bony shell. Microscopic examination of the growths shows hyaline cartilage, fibrocartilage, or possibly a mixture of the two, or connective tissue may predominate. Blood-vessels are absent in the cartilaginous tissue. Chondromata may originate from the ethmoid bone, the outer wall of the nasal cavity, or the accessory sinuses, but by far the commonest source of origin is the anterior part of the septum. The source of growth is the periosteum, the perichondrium, or the bony parts of the nose.

Symptoms.—Chondromata occur only during the first twenty years of life. The symptoms are identical with those of osteomata, with the exception of the tendency to nose-bleed; fetor of discharge is also generally absent.

Diagnosis.—Cartilaginous growths, when large, are liable to be mistaken for fibrous polypi, malignant growths, exostoses, or osteomata. Practically, fibromata may be excluded because of their rarity. When present, they bleed more easily and are less dense than cartilaginous growths. Malignant tumors are softer, bleed easily, and grow rapidly. By inspection the surgeon can readily distinguish exostoses and ecchondroses as being simple outgrowths. Bony tumors are harder and cannot be penetrated by the needle like cartilaginous growths.

Prognosis.—The chondromata have a decided tendency to recur. Growth is slow but steady, and the consequences the same as those of osteoma.

Treatment.—Extirpation, preferably with the galvano-cautery snare, is the only treatment. As operations on the tumors cause but little bleeding, the latter may be reduced by cutting with the knife, nasal saws, or cutting forceps.

NASAL MALIGNANT TUMORS.

These present two classifications,—viz., sarcoma and carcinoma. *Sarcoma* occurs more frequently than the malignant growths of epithelial origin, and is peculiar to the earlier decades of life, while *carcinoma* is found generally in people of advanced years. If non-malignant tumors are transformed into malignant ones at all, it is an occurrence of extreme rarity.

Pathology.—Sarcoma may be found as fibrosarcoma, also called spindle-celled sarcoma, myxosarcoma, round-celled sarcoma, melanosarcoma, and giant-celled sarcoma. This list also represents the order of the frequency of their occurrence. Closely allied to sarcoma is endothelioma.

The favorite location of sarcoma is the septum, especially at its anterior part, and next in order of occurrence are the ethmoid region and lateral nasal wall, in the tract chiefly of the middle and also of the lower turbinal. Sarcoma is also liable to make the accessory sinuses its starting-point. Endotheliomata almost invariably begin in the ethmoid bone, and are, as a rule, outgrowths from bony structure.

A tumor leading from the innocent epithelial growths to the malignant ones is adenoma or adenocarcinoma, composed of convoluted gland tubules with decidedly destructive and malignant tendencies in some cases, while in others they may be non-malignant. Carcinoma occurs as epithelioma, cylinder-celled carcinoma, and carcinoma with cells of nondescript character. Carcinoma, like sarcoma, has its favorite seat of attachment to the anterior part of the septum, but often originates from the sphenoidal cells, the ethmoidal cells, and the maxillary sinus,

while it is also found on the turbinals. The rapid disintegration of the growth soon hides its origin. Sarcoma generally has its source in the periosteum, the perichondrium, or the bone, and may be of myelogenic origin, having for its starting-point the interior of the osseous portions of the nose, but carcinoma always originates in the mucous membrane. The histological character of these malignant growths is like that of those of the same kind occurring in other parts of the body.

Symptoms.—Occlusion of the nares by sarcoma occurs early and becomes complete. Signs of distention of the nasal cavity soon follow, so that portions of its skeleton are forced outward. The alæ nasi are thus thrust farther apart, the orbit encroached upon, and the eyeballs displaced outward, forward, or backward, causing hideous facial deformities. The tumor not only forces the bones aside but softens and perforates them, leading to their absorption. In this way sarcoma of the nasal roof penetrates the cranial cavity. If this occur in the region of the frontal convolutions the cerebral symptoms may be slight, but if the perforation take place farther back in the parts of the cranial cavity situated above the body of the sphenoid bone, there soon appear symptoms due to pressure on the optic nerves, the abducens nerve, the third cranial nerve, and others in this region, involvement of the fifth cranial nerve resulting in violent neuralgias. If the opening into the cranial cavity be established too far forward to interfere with the nerves mentioned, the first evidence of the penetration of the growth may be a sudden meningitis or abscess of the brain, or the symptoms of gradually increasing intracranial pressure may be established. Sarcoma may penetrate the orbit through the lachrymal bone or the ethmoidal cells. Sarcomas or carcinomas of the maxillary sinus at times cause no symptoms until too large for that cavity, or they are, early in their course, the source of empyema of the antrum, that may be diagnosed while the tumor is overlooked until it has attained sufficient size to cause protrusion of the wall of the maxillary sinus, or until it has made its appearance in the nasal fossa. Nose-bleed, often of a serious character, is apt to be an early and persistent symptom of sarcoma, while sloughing and ulceration occur late in the disease and are not prominent features of its course, as in carcinoma.

In sarcoma inspection shows the naris blocked by a tumor, or in some cases this may be seen even protruding externally. The consistency of the growth in fibrosarcoma is tough; in round-celled sarcoma soft, very friable, and in some cases sloughing. Fibrosarcoma is of a pink, often whitish, hue, while round-celled sarcoma is deep red. Vascular tumors are dark or bluish red. The nasopharynx may be so filled with tumor-masses as to be closed for inspection by posterior rhinoscopy, while portions of the tumor may be visible below the soft palate.

Carcinomata do not have the tendency to displacement of surrounding structures peculiar to sarcoma, but generally ulcerate as fast as they grow,

so that there is absence of normal tissues due to the ulcerative action of the neoplasm rather than any great quantity of tumor formation: Epistaxis is far less common in carcinoma than in sarcoma, and is generally due to mechanical lesions of the growth. The chief symptom in carcinoma is its tendency to ulceration and sloughing with the putrid discharge accompanying these conditions. The breath, therefore, soon acquires a pestilential odor. In most cases the cranial cavity is soon penetrated by the growth, and meningitis or brain-abscess results. Carcinoma of the sinus maxillaris readily ulcerates into the nasal fossa, making both cavities one. In nasal carcinoma pain is a prominent feature, and is often of a neuralgic character. Inspection in carcinoma shows a ragged, ulcerated growth that bleeds when touched and is covered with sloughing tissue. This growth is seated deep in the nose, or on the septum or nasal vault, and is usually accompanied by defects in the normal tissues of the nasal fossæ, due to its destructive advance.

Endothelioma has much the appearance and character of the soft sarcomata. The nasal passages are filled with a rapidly growing, fungous, friable mass of a grayish-pink color, whose tissues offer no appreciable resistance to instruments, but are the source of free hemorrhage as soon as wounded. Recurrence is rapid and the tendency to penetrate neighboring cavities great.

Diagnosis.—In the earlier stages combination with mucous polypi or polypoid hyperplasia of the mucous membrane often makes the diagnosis of nasal malignant tumors difficult. The irritation they create causes them to be surrounded by mucous membrane in a state of chronic inflammatory œdema with polypoid formations, or else they excite suppuration of the sinuses and periostitis or perichondritis which lead to polypus formation with obstinate tendency of these growths to return. As nasal mucous polypi are frequent, they may also exist independently in a nose that has become the seat of malignant disease. Occurring from whatever cause, the polypi hide the malignant tumor from view until, after their repeated removal, the sarcoma or carcinoma begins to be apparent on account of its extension. Some sarcomata early in their growth much resemble polypi. Malignant tumors are to be suspected in connection with polypi when there is a fetid discharge from the nose without atrophic rhinitis or sinus disease to account for it, and when with polypoid growths considerable deformities of the nose occur due to distention of its bony framework with displacement of neighboring parts. This seldom happens in connection with simple mucous polypi. Histological appearances of sarcomata are often misleading because of the resemblance of their structure to that of some forms of mucous polypi. Carcinomata are more readily recognized under the microscope. Tubercular or syphilitic growths may resemble malignant tumors. Like these, tuberculous tumors are most often seated on the anterior part of the septum and turbinals. Histological examination will reveal the tuber-

cular tissue, and the involvement of other organs helps the diagnosis. Syphilomata are much harder to diagnose, as microscopically they resemble round-celled sarcoma, but the free use of potassium iodide will make the diagnosis clear.

The slow growth and hardness of osteoma and chondroma and the absence of ulceration are the chief points in their diagnosis. Bleeding polypi of the septum are differentiated by their usually remaining stationary in size and their generally pedunculated form. Ulcerated carcinomata may be mistaken for tertiary syphilitic ulcers, but there is generally some amount of tumor formation present in carcinoma, and microscopic examination of an excised piece will make the diagnosis certain. Rhinoliths and foreign bodies are often surrounded by exuberant granulations, and are accompanied by a foul discharge. As carcinoma may leave fragments of bone bare and necrosed, diagnosis may be difficult. Cleansing of the nose and the local use of cocaine will aid in differentiation by facilitating inspection.

Prognosis.—This is unfavorable in sarcoma unless its radical removal be possible. In this case the prognosis as to recurrence of the growth varies according to its histology. Spindle-celled sarcoma is least apt to return. Sarcomata growing from the medullary cavity of the bones, especially the giant-celled forms, permit a relatively good prognosis, and this is also true of melanosarcoma as occurring in the nose. The round-celled variety of sarcoma is the most malignant. As to the possibility of radical removal of sarcomata, those occurring on the septum are the most accessible and therefore most capable of complete extirpation, those seated on the lateral wall of the nasal fossa are less favorably placed for operation, while those growing from the nasal roof or ethmoidal cells furnish a bad prognosis, as thorough removal is generally impossible. In nasal carcinomata the outlook is absolutely bad.

Treatment.—When the growth is pedunculated, or it is desirable simply to remove portions for palliation of the disease, the galvano-cautery snare offers the best means for operation if it can be applied. In other cases the sharp spoon may be employed, it being understood that undertaking to remove even portions of the tumor is not a trifling matter, is sure to be accompanied by severe hemorrhage, and is liable to be followed by septic inflammations. In those cases in which the cranial cavity has presumedly been penetrated by the growth, all operative interference, even of a palliative nature, is better avoided. In most cases the methods of approach offered by general surgical operations have to be employed in order to gain access to the growth. Sarcomata offer the best chance for operation, as mentioned in the prognosis, while carcinomata are practically inoperable.

Operations generally show the tumor to be of far greater extent than inspection has led one to believe.

CHAPTER XI.

SYPHILIS AND TUBERCULOSIS OF THE NOSE.

SYPHILIS OF THE NOSE.

SYPHILIS may invade the nose in its primary, secondary, or tertiary forms, and is often of the congenital variety. Its manifestations vary from those of an acute coryza to the entire destruction of the nasal interior. For reasons unknown to pathology, the nose is a frequent seat of the destructive forms of syphilis.

Pathology.—Hard chancre is very seldom found on or in the nose, as the chances for inoculation here are not so great as elsewhere. The disease is generally conveyed by the finger-nail, but sometimes handkerchiefs, towels, or other utensils may be its carriers.

Primary syphilis of the nose may be external or be found within the nares. On the external nose it usually appears as a flat induration of moderate size, and within the nose it is most often found on the septum, existing as a red, flat, hard growth, covered with purulent secretion and bleeding easily, while at the same time the external nose may be swollen and red, and coexisting fever and neuralgic pains indicate the gravity of the infection. The submaxillary and sublingual glands and those in front of the ear become indurated.

In *secondary* nasal syphilis there may be found merely the conditions of an acute coryza; in other cases papules or macules up to the size of a pea, of the characteristic copper color, are found on the external nose, especially in the sulcus alaris, or where the nose joins the upper lip. In these locations they are apt to be fissured and have scabs crusting their surface. In the inner nose papules are seldom found back of the nasal entrance. On the mucous surface they present the usual patches of whitish, milky proliferation of the epithelium peculiar to secondary syphilis.

The *tertiary* manifestations of syphilis in the nose are of far greater importance than those of the secondary stage because of their destructiveness. Tertiary syphilis of the nose generally appears after the stage of gumma formation has passed into that of destructive ulceration. When it softens and breaks down the typical gumma leaves deep crater-like ulcers, with often only a narrow outlet, while diffuse syphilitic infiltration ends in more superficial ulcerations of the serpiginous type. This diffuse infiltration has a firm rubber-like consistency and dusky hue. Tertiary ulcers may penetrate to the periosteum and perichondrium and cause death of cartilage or bone, or else these structures may necrose as the result of gummatous periostitis, perichondritis, or osteitis,

the destructive process starting in the depths of the tissues and working to the surface. Gummatous syphilitic infiltration quite often also attacks the external nose, causing brawny thickenings which may result in destruction of portions of the organ when ulceration occurs. The extent of necrosis due to tertiary syphilis varies. In many cases the destructive changes are limited to a perforation of the septum, usually its bony portion; in others the perpendicular plate of the ethmoid bone or the vomer, or both, are lost. In cases of still greater severity the entire septum and turbinates are destroyed, or to the loss of all the bones of the nasal interior is added perforation of the hard palate or complete loss of this with destruction of the soft palate as well. This extensive necrosis of the bony structures occurs in the type of syphilis called malignant, a form of tertiary syphilis which may even result in death of the sphenoid or ethmoid bones, with opening of the cranial cavity, meningitis, and brain-abscess. In some cases of nasal syphilis the inner or lower wall of the orbit is the seat of necrosis. Destruction of the septum alone does not cause the bridge of the nose to fall in; this occurs when the nasal bones are also involved in the disease and become necrotic. The result is the type of deformity called the saddle nose, in which the nasal bridge is depressed while the tip is elevated. Cicatricial shrinkage of the parts within the nose may draw the cartilaginous portion of the external nose back towards the nasal interior, making the rim of the *apertura pyriformis* appear as a ridge.

Symptoms.—As is the case in all extragenital chancres, the symptoms of primary syphilis of the nose are apt to be very severe and the initial lesion of large size, while the infected lymph-glands may form large tumors. Chancre in the nasopharynx or posterior nares is difficult of detection. The symptoms of secondary nasal syphilis are those of an acute nasal catarrh of protracted course, and condylomata within the nose may cause obstructed breathing.

Tertiary syphilis of the nose is apt to occur in the period between the first and third years after infection or during a second term between the fifth and fifteenth years after the disease has been acquired; in fact, this is the time of greatest danger. The mildness of the symptoms accompanying tertiary nasal syphilis does not make the patient aware of the gravity of his affection, so that he is apt to present himself for treatment after irremediable destruction has occurred.

The first symptoms are those of a chronic cold in the head, with stopping up of the nose, anosmia, and watery secretion which later becomes purulent, offensive, and bloody, and crusts, often of great size, are blown from the nose or hawked down the throat. The breath may become very foul, and neuralgic pains are felt radiating into the orbit, forehead, ears, and especially the upper incisor teeth (nasopalatine nerve). The external nose and cheeks may be red and swollen, with œdema of the lids.

Inspection in primary and secondary syphilis shows those conditions described in the pathology of this article. In tertiary disease, if seen early enough, the surgeon may find the gumma or diffuse infiltration already described, usually seated on the septum, though any part of the nasal interior may be involved. The disease generally attacks the turbinals in the form of a diffuse syphilitic infiltration that enlarges them until they touch the septum. This swelling resembles that of hypertrophic rhinitis, for which it may be mistaken. It does not retract under the influence of cocaine, or only very slightly, and is apt to conceal ulcerations farther back in the nose. The ulcerations in tertiary syphilis of the nose generally present the clean-cut border, yellow base, and hard, infiltrated surroundings of the syphilitic ulcer.

When the disease begins in the periosteum or perichondrium the infiltrations or ulcerations described will not be seen, but a smooth, elastic swelling will present itself, usually on one or both sides of the septum,—a periostitic abscess. When this is opened, bare necrotic bone will be found at the bottom of its cavity. The majority of the cases of tertiary nasal syphilis which present themselves have passed through these earlier stages of the disease, and seek treatment on account of the fetid discharge, offensive breath, and deformities resulting from the destruction of portions of the bones of the nasal cavity. To be able to examine these patients one must first cleanse the nose of the crusts and pus. In the milder cases a circumscribed necrosis may be invisible, and only discoverable with a probe. In some instances all ulceration may have ceased and the dead bone be enclosed in healthy granulating tissue; in others one may find active ulceration, together with defects in the bony tissues, caused by the separation of sequestra. The necrosed portions of bone may lie loose in the nasal passages or be firmly attached to their location, and it may take a long time—even a year or more—before the dead bone becomes loosened and ready for removal. In those cases in which there is loss of the septum, or septum and turbinals, the appearance of the nasal interior is that of a single large cavity lined with offensive dried secretion. One of the consequences of tertiary syphilis of the nose is atrophy of the mucous membrane and turbinals; so that in some patients, after the destructive process has run its course, conditions are found like those of atrophic rhinitis, and washing away of secretions shows merely an atrophied, not an ulcerated, mucous membrane.

Perforation of the hard palate signalizes itself by a red swelling appearing generally on one side of the raphe. This grows larger, becomes dusky in color, and finally a deep yellow ulcer forms in the centre, at the bottom of which the probe comes upon exposed bone. This process may continue to extend until the whole of the hard palate is destroyed. The rapid destruction of the bones of the nose in syphilis is due chiefly to the extension of periostitic abscesses, which separate the periosteum from the bone and cause its death over large areas. The necrosed bone has an

almost black color, and may be so large that it cannot be removed until it has been cut down.

Diagnosis.—A general knowledge of the phenomena of syphilis is essential, as from local signs alone one cannot always make a diagnosis. The nature of a hard chancre of the nose may not be recognized until secondary symptoms make their appearance. It has been mistaken for a malignant growth. The most valuable symptoms are the characteristic hardness and great swelling of the lymphatic glands.

The secondary stage of the disease can be distinguished from subacute rhinitis by the appearance of mucous patches or condylomata in the nose, or, if these be absent, by syphilitic phenomena elsewhere.

Tertiary syphilis of the nose is easy to recognize when the characteristic bony destructive processes have occurred, but earlier in the affection the diffuse infiltration of the turbinals may resemble the conditions produced by hypertrophic rhinitis, and the history and results of treatment may be needed for diagnosis. Rarely, however, the turbinals alone are affected, and some ulceration of the pharynx or tonsils or other syphilitic manifestation will aid in distinguishing the disease.

Syphilitic periostitic abscess of the septum may be mistaken for a simple abscess in this locality, and the history of the case and treatment alone can help to a decision. Lupus is distinguished from syphilis by its occurring at an earlier age than any form of syphilis except hereditary. In the beginning the peculiar reddish papules or tubercles of lupus are quite distinct from any syphilitic manifestations, and later the marked preference which lupus shows for the cartilage is characteristic. The disease process is also much slower in lupus.

As mentioned above, in the postsyphilitic stage there may exist a state of the mucous surface which is essentially an atrophic rhinitis, but the bony defects and septal perforations remaining after syphilis distinguish it. Earlier in the disease, when it is in its active stage, the only thing that tertiary syphilis of the nose has in common with atrophic rhinitis is the odor, which is asserted to be of a different order in nasal syphilis from that occurring in ozæna. After removal of the secretions, the destruction wrought by syphilis, the characteristic ulcers, and the necrosed bone should enable even the inexperienced to make a diagnosis.

Prognosis.—Everything depends on early recognition of the disease, as in all but the malignant cases treatment will promptly check it. That the disease is generally not promptly recognized is proved by the number of noses seriously deformed by it. When there are ulcerations on the turbinals accompanied by great swelling, there may be cicatricial adhesions which unite the turbinals to the septum and prove very troublesome to treat.

Treatment.—Syphilitic coryza requires no other treatment than the internal administration of tonics and the local use of mild alkaline sprays or washes. Indeed, secondary symptoms usually require only mild con-

stitutional treatment and touching of the condylomatous growths or mucous patches with tincture of iodine or silver nitrate. In tertiary syphilis treatment must be very energetic, as the disease can do enormous damage in a few days. When the symptoms are not very urgent, one can begin with small doses of potassium iodide, and gradually increase these until the patient is taking from thirty to sixty grains three times a day; but if the integrity of important structures be threatened,—as, for instance, if the hard palate seem to be in danger of perforation,—it is necessary to begin with doses of at least thirty grains of potassium iodide three times daily. Potassium iodide is best tolerated if given an hour or two after meals and diluted with a tumblerful of water or milk; this enables the patient to bear quite large doses from the start. In these threatening cases the drug should be rapidly pushed to the limit of physiological tolerance, and continued until some weeks after all syphilitic manifestations have ceased. Local treatment is extremely important. Periostitic abscesses should be opened early, to prevent the burrowing of the pus under the periosteum. Crusts and foul dis-

FIG. 129.



Ingals's nasal dressing forceps (three-fifths natural size).

charges should be washed away two or three times a day with an alkaline solution containing one-fourth of a grain of potassium permanganate to the ounce. Deep ulcerations are favorably influenced by the stimulation of a mild caustic application, and among these tincture of iodine seems to be the most effective. This will also promote the healing of superficial ulcers, though these will heal rapidly enough without local treatment. So favorable is the influence of cauterizations on syphilitic ulcers of the mucous membrane that they frequently heal as the result of superficial burns with the galvano-cautery without any constitutional treatment.

Applications of strong tincture of iodine should be made daily for from ten to fourteen days until evidence of cicatrization appears, and then every other day for a week or more, and subsequently less often. When the active advance of the disease has been checked, the remaining sequestra of dead bone cause a great deal of trouble. As long as necrotic bone is present in the nasal cavity the offensive odor and discharge will not cease, and yet it is not advisable to attempt to remove the offending

fragments until they have become loosened from the surrounding healthy bone as the result of the formation of granulations, unless the necrosed mass be very large or cause extreme fetor. In some instances it may take a year or even longer before the sequestrum is movable. When the fragment is loosened, its large size or shape may make it impossible to extract it without great force and laceration of the soft parts. In such cases it has been recommended to soften portions of the fragment by decalcification with commercial hydrochloric acid. This is applied by means of a copper probe with a roughened end to such portions of the sequestrum as can be reached. If the soft parts be burned by the acid, this is to be quickly neutralized with an alkaline wash. The softened parts can then be scraped off and the fragment reduced in size.

When the piece of bone is loose in the nasal passages and is too large to extract, it can be held steady with nasal forceps while cores are drilled from it with the nasal trephine attached to the dental engine. After it has been weakened in this way it can be broken up with nasal bone-forceps. Usually the latter is sufficient without the trephine.

Mercury in some form may be employed as an aid to the action of potassium iodide. Inunctions are especially to be recommended, as their influence is rapid and the digestive organs are spared. In most cases of tertiary syphilis mercury is not as efficient as potassium iodide, but there are some which will not improve until mercury be employed.

Congenital Syphilis of the Nose.—The more recent the syphilis of the parents the earlier will the affection appear in the offspring. Abortions, therefore, mark the earlier stage of the disease in the parents, while later premature infants may be born showing the marks of the disease. Children born at a period still later than this may not develop symptoms of syphilis until weeks or months after birth, and when the disease has progressed to the tertiary period in the parents, the offspring may not show any signs until tertiary symptoms occur years after birth.

Symptoms.—Nasal symptoms are among the most prominent of the features of hereditary syphilis. The earliest of these is syphilitic coryza, which makes its appearance generally from three to four weeks after birth. The nasal obstruction may prevent the infant's nursing, and so prove a serious danger to its life. Yellowish or brownish crusts are found adhering to the nostrils, which may be raw, cracked, and fissured, on account of the irritating discharge, that is at first watery, perhaps tinged with blood, and later becomes mucopurulent, finally drying into thick scabs, often of an offensive odor. The discharge causes the upper lip to become red, swollen, and excoriated, while the external nose is often congested and swollen. Syphilitic coryza is due to secondary syphilitic changes on the nasal mucous surface, notably syphilitic erythema. Tertiary disease is rare in the first year of life, but in some instances caries

of the bones and cartilage occurs with, at times, disfigurement for life. An obstinate obstructive nasal catarrh occurring in infants is generally indicative of congenital syphilis, and indeed may for a time be its only symptom. The swelling of the mucous surface makes inspection of the nares usually impossible until the disease begins to improve. The infants are, as a rule, puny, senile in appearance, and present a roseola syphilitica, with crusting fissures of the corners of the mouth and rhagades of the lips, loss of hair and eyebrows, and other signs of secondary syphilis. Infants with congenital syphilis are by no means always atrophic in appearance, but may look plump and well nourished.

Congenital tertiary nasal syphilis may make its appearance at any time during the first two decades of life, or in rare cases may even attack the patient later. Nearly all cases of the disease occur before puberty, however. Children affected with it are apt to present the so-called Hutchinson's triad of signs,—namely, notched upper incisor teeth, chronic keratitis or its remains, and deafness. In some cases secondary symptoms are absent, and the first manifestation of the disease is of a destructive tertiary character, the so-called syphilis hereditaria tarda. In congenital tertiary nasal syphilis the symptoms are apt to be very obstinate and intractable, and the disease may malignantly progress to a fatal termination, destroying all the tissues in its path, the hard and soft palate, the walls of the orbit, and the roof of the nasal cavity, in spite of heroic treatment with large doses of potassium iodide and mercury.

Diagnosis.—Chronic coryza in infants is liable to be mistaken for this affection, but differs from it in the general appearance of the patient and the absence of secondary syphilitic symptoms.

Prognosis.—The affection runs a chronic course, with little or no tendency to spontaneous recovery. Relapses are numerous, and, as mentioned, the disease may assume a malignant form. Many of the children remain puny and die young, but some grow up to vigorous manhood or womanhood.

Treatment.—Mercurials and potassium iodide are indicated internally, and local treatment is generally desirable, though in young children it is very difficult to carry out. Mackenzie prefers mercury with chalk, which he administers in doses of from one to two grains twice daily, to which he adds, if this cause diarrhoea, one grain of Dover's powder or an additional grain of chalk. Erichsen recommends the external application of mercury in the following manner, proposed by Brodie: a drachm of mercurial ointment is spread upon a flannel roller, which is bound around the child's thigh just above the knee, the ointment next to the skin. This is renewed daily for two or three weeks, after which potassium iodide is administered in milk, cod-liver oil, or malt. Milk and water are the best vehicles for the administration of the drug to either children or adults.

granulation neoplasms, is destructive. When tubercular new formations are destroyed by ulceration, their remains present the appearances just described as tubercular ulcer. The tubercular tumor is the typical form of primary nasal tuberculosis,—that is, it often exists without tubercular disease elsewhere.

The third type of nasal tuberculosis is that of diffuse infiltration, which, like the other forms, is prone to attack the septum, but may also invade the turbinals. It forms firm, resistant swellings of a pale color with granular surface. Ulceration follows, and leads to perforations of cartilage or bone with the formation of fistulæ.

The fourth type of tubercular nasal disease may be characterized by such an exuberance of granulations that the latter may hide ulcers, perforations, and tumors. They are analogous to the fungous granulations found elsewhere in the body. Microscopically, all these forms of nasal tuberculosis show the well-known structure of tubercular tissue. In the infiltrative and tumor form bacilli are sparingly present, but in the secretion from the ulcerations they are apt to exist in abundance.

Symptoms.—The ulcerations give rise to a purulent discharge, which is often offensive and usually collects in the form of scabs and crusts. Nose-bleed is an occasional occurrence. There is but little pain, and the course of the disease is slow and insidiously destructive, so that finally bone and cartilage yield to its advance, most cases, later in its course, showing perforation of the septum of varying extent. The nasal tuberculosis may be the primary invasion of the organism by the disease, and is generally followed by laryngeal or pulmonary phthisis. In the majority of cases nasal tuberculosis is preceded by tuberculous disease elsewhere in the body.

Diagnosis.—To distinguish syphilis of the nose from nasal tuberculosis may be difficult, especially in the late forms of hereditary syphilis. The more rapid course of syphilis, the headaches and neuralgias apt to accompany it, and its proneness to attack the bones, while tuberculosis assails the cartilage, are qualities that help to distinguish it from tuberculous disease. Lupus generally progresses from the integument inward, and shows a tendency to cicatrize in places, while its course is extremely slow. As lupus and tuberculosis represent merely modifications of the same disease, the form of lupus originating in the nose is often indistinguishable from tuberculosis and resembles the infiltrative form of the latter.

Tuberculomata disintegrate early by ulceration, and in this differ from the nasal neoplasms. Carcinoma may be distinguished by its protuberant, hard borders and the fact that it is usually a disease of later life. Sarcoma has a rapid growth.

Microscopic examination of the tissues will not always lead to a clear understanding, as syphilitic infiltrations, sarcomata, hypertrophies, and other conditions may present histological appearances very much like those of tuberculosis. When the presence of tubercle bacilli can be

TUBERCULOSIS OF THE NARES.

Tuberculosis of the nares is an affection of great rarity, and may be primary or secondary to tuberculosis elsewhere in the body. Though infection with the tubercle bacillus is the cause of both lupus and tuberculosis of the nasal passages, the clinical features and pathological findings of the two affections are different.

Pathology.—In most cases the disease affects the septum, especially its anterior part. Tuberculosis may, however, affect any part of the nares, or appear in the nasopharynx. It shows itself in the form of a tubercular ulcer, tumor, diffuse infiltration, or as exuberant granulations. The last two forms are anatomically identical with the changes produced by lupus, and it is but natural, considering their common origin, that the pathological conditions produced by lupus and tuberculosis should thus merge into one another.

The ulceration may result from the breaking down of tubercular tumors or infiltrations or present itself as an ulcer from the start. Tubercular ulcers are most often secondary to pulmonary tuberculosis. They are usually seated on the most anterior part of the cartilaginous septum; but have been seen on the turbinals and in the choanæ, where they are accompanied by great swelling and infiltration of the tissues. The typical tubercular ulcer may be as large as a cent, and is generally solitary. The form of the ulcers is round or oval, with irregular borders, and they are generally hidden by adherent scabs of muco-pus. When these are removed there is found the appearance typical of tubercular ulcers in other locations on irregular, worm-eaten borders, the floor of the ulcer being of a pale grayish-red color and sometimes covered with granulations. The borders may be level or prominently raised by tubercular infiltration, while miliary tubercles may be seen on the floor of the ulcer or surrounding it. They present a translucent grayish- or yellowish-white color, and, as they are constantly breaking down at the edge of the ulcer, they make its border irregular and ragged. Unlike the ulcerations of lupus, the tubercular ulcer shows no tendency to cicatrize. Though shallow at first, tubercular ulcers finally penetrate the cartilage and bone by erosion of these structures by granulation-tissue, leading to caries and perforations. This is the reverse of the course of necrosis in syphilis, which is generally due to primary perichondritis or periostitis, and perforates the mucous surface from within.

The tubercular tumor is a form of tubercular tissue that has less tendency to disintegration than the tissue forming the floor of the tubercular ulcer; therefore tumors of considerable size, even as large as a walnut, are formed before it breaks down. These growths generally originate from the cartilaginous septum, but may extend to the floor of the nose or the turbinals. They may be of broad base or pedunculated, and bleed readily when touched. The tubercular tumor, like other

CHAPTER XII.

EMPYEMA OF THE MAXILLARY ANTRUM.

Synonymes.—*Sinuitis maxillaris acuta, sinuitis maxillaris chronica.*

INFLAMMATION of the mucous lining of the antrum of Highmore may be acute or chronic. It is accompanied by a discharge of a serous, mucous, mucopurulent, or purulent nature, often of offensive odor. In some cases the mucous lining of the antrum furnishes no secretion, the symptoms being caused by the swelling of the mucous membrane.

Etiology.—Acute inflammation of the maxillary sinus often accompanies acute rhinitis and influenza. In influenza the discharge is frequently purulent and the inflammation more severe than in simple acute rhinitis.

The acute infectious diseases—pneumonia, typhoid fever, measles, scarlet fever, diphtheria, and small-pox—often give rise to acute inflammations of the antrum. Inflammatory disturbances in the neighborhood of the maxillary sinus are liable to involve it by extension; this is especially the case in disease of the teeth of the upper jaw. Decay opens the pulp-cavity, clearing the way for infectious germs to follow the root canals to the periosteal lining of the socket of the root of the tooth. Here an abscess may form around the root, and if the lamella of bone separating it from the cavity of the antrum be thin, or, as in some cases, even wanting, infectious material may readily penetrate into the maxillary sinus, setting up an acute inflammation. It is not necessary, however, that pus should actually enter the antrum from the root abscess. The septic inflammation may travel through the bone, which becomes inflamed as a sequel to the periostitis. In this way a tooth whose socket is not situated under the antrum—as, for instance, an incisor tooth—may excite empyema by causing osteitis of the alveolar process; similarly, periostitis or osteomyelitis of the upper jaw from other causes may give rise to empyema of the antrum. Disease of the roots of the first and second molars is most liable to be followed by sinuitis, as the bony covering between them and the sinus maxillaris is apt to be thinner than in other places. The third molar and first bicuspid rank second in their liability to originate antrum disease. In rare cases the antrum extends as far as the cuspid tooth. In children the germs of the second teeth separate the bottom of the antrum widely from the teeth of the first set until second dentition, and up to this period empyema of the antrum is practically unknown. Root abscesses are generally accompanied by absorption of the bone about them, a process which favors penetration by infectious material of the tissues separating them from the antrum.

Dental cysts forming at the roots of teeth may suppurate and burst into the maxillary sinus, causing empyema.

In the extraction of teeth injury has been done to the bony partition between the root socket and the floor of the antrum, especially if the tooth has been crowded towards the antrum in order to take a firm hold. In this way an opening has been established between the oral cavity and the antrum, with the possibility of infection by food particles, or else septic matter around the root has been forced into the antrum.

Objects causing penetrating wounds of the antrum may create empyema, especially if they be infected or leave foreign bodies in the maxillary sinus. *Ascaris lumbricoides* has been known to enter the antrum through the natural opening.

The causes of chronic empyema of the antrum include those of the acute disease, from which it often originates.

Chronic empyema is found associated with atrophic rhinitis, and in some cases this ailment is to be regarded as a sequel to the empyema. Simple and malignant tumors of the antrum are quite sure to excite empyema.

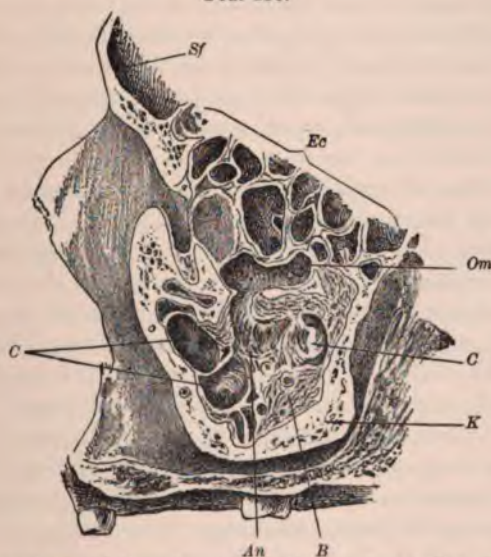
Pathology.—Acute inflammation of the mucous surface of the antrum presents the usual hyperæmia of acute catarrhal inflammation elsewhere. The mucous membrane is reddened and congested, and has a marked tendency to form localized or general watery œdematous swellings, at times so great as to fill the cavity of the antrum. As the veins of the antrum pass through its narrow nasal orifice in the hiatus semilunaris, or else find their way through bony canals in its walls, it is plain that very moderate swelling of the soft parts lining these outlets will compress the veins and cause œdema. Microscopically, the tissues of the mucous membrane are found infiltrated by leucocytes, sometimes very densely, while hemorrhagic extravasations may be present. The epithelium is generally found intact. When the secretion is purely mucous it may be of a thick, jelly-like consistency or thin and almost watery. Among the numerous micro-organisms found in acute catarrh of the antrum the most important are the diplococcus of pneumonia, streptococcus, staphylococcus, and the bacillus capsulatus mucosus. In rare instances the mucous membrane may be covered with a false membrane in which the bacillus of diphtheria has sometimes been found.

The pathological appearances in chronic inflammation of the maxillary sinus do not differ from those of the acute variety until they have lasted a long time; then formation of new connective-tissue growth takes place, and sometimes infiltrates the mucous and submucous tissues to such an extent that the lumen of the antrum is almost obliterated by their dense hyperplastic thickening. The tough fibrous structure of the mucous membrane is firmly attached to the bony tissue underneath. The surface of the lining of the antrum becomes rough and uneven, and is often covered with warty or polypoid excrescences. The periosteum is

also affected by the process, and osteophytes and small bone-plates are found within the thickened submucous tissues.

The exudation found in the cavity of the antrum is, as a rule, purulent or mucopurulent, but may also be serous or mucous, as in acute sinusitis. Deposits of cheesy masses of inspissated leucocytes, fat-crystals, and other residual material may cover the walls of the antrum or even fill its cavity. All varieties of micro-organisms are found in chronic sinusitis of the maxillary sinus,—pneumococcus, staphylococcus, streptococcus, bacillus coli communis, bacillus capsulatus mucosus, bacillus pyogenes foetidus. They are not necessarily responsible for the continuance of the disease. The secretion is far more apt to be fetid in chronic inflammation of the antrum than in acute sinusitis.

FIG. 130.



Changes in the second stage of chronic empyema of the antrum of Highmore. (Heymann.) *An*, antrum; *Sf*, sinus frontalis; *Ec*, ethmoidal cells; *Om*, opening of the maxillary sinus; *K*, greatly thickened eburnated bony wall of the antrum; *B*, thickened mucosa composed of cicatricial connective tissue; *C*, cysts.

Symptoms.—The symptoms of acute inflammation of the maxillary sinus may be mistaken for those of neuralgia of the superior dental or supra- or infraorbital nerves accompanying an acute cold in the head, and it is probable that antrum disease is often not recognized because of its obscure symptoms.

In the milder cases acute sinusitis of the antrum will cause but little distress, but in those of severer grades there are fever, seldom more than moderate, and pain, often of great severity. The patient's first sensations are usually weight and distention in the upper jaw, but soon this changes to actual pain in this locality,—a pain which is apt to radiate into

the teeth, the temples, or the orbit, causing photophobia and lachrymation, with, in some cases, pain in the eyeball. There may also be supra-orbital neuralgia, hemicrania, or headache. Sneezing, coughing, bending forward,—in fact, anything creating venous congestion in the head may greatly add to the pain. Swelling of the cheek, extending sometimes to the lids, with, in some cases, reddening of the surface, may occur. The discharge may appear at once in the nose or after several days, apparently forcing open the ostium of the antrum by pressure. When this occurs there is great relief from the pain, which may, however, return several times as the cavity refills. When the secretion bursts from the antrum in a sudden manner, it is apt at first to flow freely from the nostril, the character of the outflow being that described above. When decayed teeth have produced the disease, the discharge is generally very offensive.

Acute inflammation of the maxillary sinus lasts, as a rule, from one to three weeks, unless it merges into the chronic form. It may involve both antra, and one attack is liable to be followed by others. Unusual occurrences are œdema of the lids, conjunctiva, and cellular tissue of the orbit, with exophthalmos, and sometimes temporary diminution or loss of vision.

The chronic form of empyema of the antrum may be latent, the discharge not having noticeable characteristics, while there are no subjective symptoms. In a typical case the patient's chief complaint is of the discharge, which is generally pus or muco-pus, but in rare cases it is serous or mucous. The position of the outlet of the antrum near its top makes drainage of this cavity imperfect, so that in the upright position it has to fill to the level of the ostium before discharge of secretion can occur. Accessory outlets, however, may exist, and are found just above the lower turbinal. Certain conditions which temporarily increase the flow of secretion have diagnostic value. Thus, if the patient lie on the healthy side or invert his head or bend forward, the fluid contents of the antrum may, for mechanical reasons, discharge more freely. A similar effect may be obtained with the Politzer air-douche or by aspiration produced by swallowing while the nose is closed with the fingers. The discharge may be so free that it comes drop by drop, or so scanty that it dries into crusts. Swelling of the mucous membrane about the outlets or the pressure of the polypi and hypertrophies so often found about them in this disease may impede the discharge, which will, however, slowly leak through in spite of these obstructions as soon as the pressure within the antrum, due to accumulated secretion, is sufficiently great. The discharge flows into the middle meatus, and from here may spread forward or downward upon the nasal floor or back into the nasopharynx, which it may cover in fluid form or coat with scabs when it dries. Hypertrophies or polypi underneath the middle turbinal may keep the pus from appearing in the forward part of the nose. The putrid odor and taste of the secretion are disgusting to the patient, and keep him hawking, spitting, and blowing

his nose, and, if swallowed, the pus may nauseate him and cause vomiting. The secretions may collect in the nasopharynx overnight, whence they are hawked with great difficulty.

Through direct extension of the inflammation from the antrum, or more often by reason of the irritating nature of the discharge, the nasal mucous surface becomes diseased in about one-half of the cases of empyema of the antrum. This is especially the case in the purulent form of the disease, but may occur when there is serous, mucous, or no discharge. The nasal manifestations consist of hypertrophies of the mucous membrane and polypi which form about the outlet of the antrum in the hiatus semilunaris or on the processus uncinatus and the middle turbinal.

Pain is not so prominent a symptom as in acute sinusitis. There may be a local aching and feeling of weight, but usually these are absent, while neuralgic pains are felt in the teeth, temple, eye, forehead, or one-half of the head. At times there is simply a headache, often of a severe character. These reflex neuralgic pains originate from the sensitive mucous lining of the antrum, and because of direct irritation of the branches of the superior dental nerves as they course along the walls of the maxillary sinus, the bony canals in which they are contained being in places devoid of their osseous covering. Mental symptoms of empyema of the antrum are forgetfulness, inability to concentrate the mind, and sleepiness. Reflex eye symptoms also occur: pain in the eyeballs, lachrymation, weakness of accommodation, and diminution of the acuteness of central vision and of the visual field. Hyperæmia and neuritis of the optic nerve may occur. The suppurative process may extend beyond the cavity of the antrum. Ulceration of its mucous membrane and inflammation or localized necrosis of its bony walls usually precede this. It is not necessary that the bony wall of the antrum should actually be perforated by the pus, as the septic inflammation may pass through it by causing osteitis and periostitis. In this way abscesses beneath the cheek may form, or dangerous phlegmons of the sphenomaxillary fossa. Abscesses and fistulæ of the hard palate occur. When the suppuration extends to the orbit, great swelling of the lids, chemosis, exophthalmos, and partial or complete blindness result. The orbital abscess thus formed may burst through the lids or enter the cranial cavity by the optic foramen, leading to meningitis, or the orbital roof may be perforated or inflamed and give passage to infection, resulting in abscess of the frontal lobe.

Dilatation of the antrum of Highmore due to the pressure of retained secretions is an occurrence of great rarity. The obliteration of the opening or openings is ordinarily caused by inflammatory thickenings or cicatricial contractions of the mucous membrane surrounding them, changes which are the result of the chronic sinusitis itself. Distention of the antrum is far more apt to occur as the result of slowly growing dental cysts, which in time fill the entire cavity of the maxillary sinus and dilate its walls. The same condition may result from the

presence of a mucous polypus in the cavity, but is more frequently caused by malignant neoplasms which have their origin in it than by any other condition.

Diagnosis.—The most important of the subjective symptoms in the diagnosis of empyema of the antrum is that of a unilateral fetid purulent discharge from the nose, often accompanied by the neuralgic pains mentioned, the discharge being increased by certain positions of the head. When these classic symptoms of the disease exist they strongly suggest empyema, and the patient's voluntary statements describing them may be so characteristic as to lead the surgeon at once to suspect the disease. In other cases these symptoms may be absent, or so obscured and overshadowed by those caused by the intranasal hypertrophies and the nasal mucous polypi resulting from the irritating discharge that the surgeon is led to think of disease of the nasal passages rather than of the antrum. The most characteristic sign discovered by inspection is a flow of pus in the middle meatus, which is slowly or rapidly replaced after it has been wiped away, and which gives a foul odor to the swab used for the removal of the discharge. After changes of the position of the head, or the use of the Politzer air-douche, it may be found that the pus escapes more freely. It may be necessary to remove polypi and hypertro-

phies before inspection will show these characteristic signs. A valuable, but at times misleading, aid to diagnosis is furnished by transillumination. A three- to six-volt electric light, enclosed in a small glass dome to prevent its burning the patient's mouth, is placed a short distance



Ingals's electric lamp (one-half natural size).
For transillumination.

tance back of his incisor teeth. He is then told to close his lips firmly, when his face will present a pink glow in the region of the cheeks, with darker shadows above. Under ordinary conditions his eyes will also appear as two faintly reddish spots, surrounded by the dark ring of the orbit. Under favorable conditions the pupils are visible as two faintly lighted disks. This examination is of value only if it take place in a dark room or closet, or under a dark cloth, as in photography. The current must be strong enough to make the light burn brilliantly white. The portions to be especially observed are the pupils and the region immediately beneath the lower border of the orbit. Should these parts appear illumined on one side of the face and dark upon the other, it does not necessarily mean that there is a collection of pus in the antrum, as unusual thickness of its bony walls, or smallness of its cavity, or an hypertrophic state of its mucosa, or asymmetry of the upper jaw, making one antrum smaller than the other, may cause the difference in illumination. When the facial bones are strong and heavy, as they are apt to be in men, the illumination of the eye and infraorbital region may be

insufficient on both sides to permit transillumination to be of value as an aid to diagnosis. During the illumination the patient normally perceives a red glow in both eyes; if he does not see it in one or the other, it will show that for some reason the light has failed to pass through the antrum on that side, and that empyema is a possible cause. It is, however, hard to locate the subjective sensation of the light sufficiently to tell whether one perceives it in one or both eyes. On account of their lighter facial bones, women are better subjects for transillumination than men. It is to be remembered that a dental plate will constitute an obstacle to the light. Taken alone, transillumination is of little value, but in combination with other signs of maxillary sinusitis it is of great service in confirming the diagnosis of empyema, and in obscure cases of nasal disease may lead one to suspect the existence of pus in the antrum, and induce him to apply other methods of investigation. These are probing of the antrum, insufflation, irrigation, and aspiration. To pass a probe through the normal opening of the antrum in the hiatus semilunaris is possible in about two-thirds of the cases. The probe to be employed should be about one-twenty-fourth of an inch in thickness, and should have an olive-shaped point. It should be bent at an angle varying between one hundred and ten and one hundred and eighty degrees; the bent extremity should be from one-fourth to five-sixteenths of an inch in length. The probe should be insinuated, beak upward, into the middle meatus about as far as the centre of the middle turbinal; here the point should be turned outward at an angle of from ninety to one hundred and twenty degrees to a vertical line, when by moving it about a little it may be made to glide into the opening of the antrum. A valuable guide is the sensation obtained as the extremity of the probe hooks behind the processus uncinatus. When the probe has been introduced, pus will sometimes flow out beside it. A fine silver tube, bent in the same manner as the probe, may next be introduced, and used to blow secretion from the antrum by connecting it with an insufflator. If this be unsuccessful, it may be joined to a syringe and the antrum irrigated, so as to wash out the pus. It is better to use insufflation first, as, if the fluid contents of the antrum be serous, they will invisibly mingle with the irrigating fluid. If the antrum cannot be entered by the normal opening, a sharply curved trocar and canula or a curved hollow needle may be thrust into its cavity

FIG. 132.



Vohsen's transillumination lamp, with glass dome over it to prevent heating of mouth, and rubber cylinder to be slipped over light for illumination of frontal sinus.

and probing should make it impossible to mistake them for empyema. Tertiary syphilis of the nose presents, as a rule, ulcers and necrosis on both sides of the nose, and has only the foul discharge in common with empyema, to which it very rarely gives rise. Empyema of the antrum may coexist with atrophic rhinitis, and may in some cases cause it. In disease of the sphenoidal sinus the discharge appears in the superior meatus and is found in the nasopharynx. Tumors of the antrum generally cause empyema, but distend the antrum when they have grown sufficiently, while simple suppuration very rarely does this. Dental cysts have generally no communication with the nose, so that when they are opened from the alveolus, fluids used for irrigation will not appear in the nasal cavity. In the rare instances in which they perforate the nasal wall of the antrum they do so in the lower meatus, so that the water injected into them will run into the nose in this situation. When dental cysts have been emptied they usually soon cease discharging.

Prognosis.—Acute sinusitis generally ends in spontaneous recovery, but may merge into the chronic form of the disease. Like suppuration elsewhere in rigid-walled cavities, chronic empyema of the antrum shows no tendency to spontaneous recovery. Left to itself, the disease usually continues for years or decades, presenting about the same symptoms, while the nose gradually becomes occluded by hypertrophies and mucous polypi. Even after the antrum has

been opened by operation and irrigation employed the hypertrophied and degenerated mucous membrane may continue to secrete pus, while existing pockets and recesses of the cavity keep up the discharge because imperfectly drained. In such cases radical operations which open the antrum broadly and permit packing and curettement may bring about recovery; but even here, in some instances, all that can be attained is improvement. It is, therefore, well to be cautious in promising recovery, as this may be long deferred, require radical operations for its accomplishment, or be impossible of attainment. A large proportion of cases, however, will get well as the result of drainage and irrigation, some speedily. The extraction of an offending tooth may have a favorable

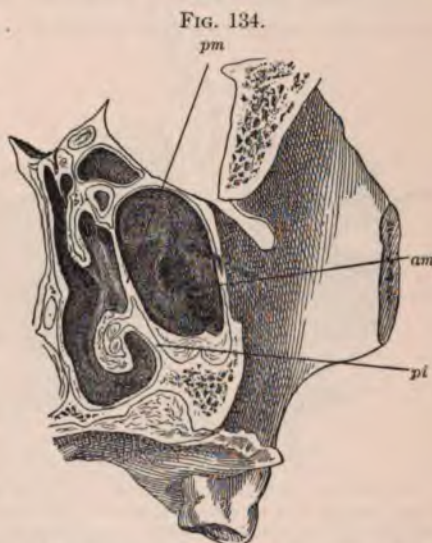


FIG. 134.
Transverse section through the antrum of Highmore. (Heymann.) *am*, antrum; *pm*, position for puncture with trocar in middle, and *pi*, in lower meatus.

shown, the diagnosis will become clear. The patient must always be examined for latent tubercular disease elsewhere, while his temperature should be systematically taken.

Treatment.—When nasal tuberculosis accompanies advanced pulmonary consumption, or when the patient's vitality is low, an attempt at radical removal of the disease in the nose is useless. The treatment of the disease is mainly surgical, but even in the primary cases does not offer a guarantee against relapses, as it is almost impossible to remove every vestige of the tubercular tissue that extends far beyond its apparent limits in the form of miliary foci or lymphatic involvement.

The first attention must be given to the general health of the patient, as his vitality is the chief weapon against the disease. It is impossible to make tubercular ulcers cicatrize while the patient is losing weight and strength.

Tuberculous tumors should be removed with the cold or hot snare. Infiltration of tuberculous matter or fungous granulations are best destroyed by curettement with a sharp spoon. This is to be followed by the application of lactic acid in the strength of from fifty to one hundred per cent. This can also be applied to ulcers without previous scraping, if they be clean-cut in appearance and seem to have but little tuberculous tissue in their floors.

Treatment of the ulcerated surface by carefully touching it from time to time with the galvano-cautery has been recommended and is advantageous in some cases.

CHAPTER XII.

EMPHYEMA OF THE MAXILLARY ANTRUM.

Synonymes.—*Sinuitis maxillaris acuta, sinuitis maxillaris chronica.*

INFLAMMATION of the mucous lining of the antrum of Highmore may be acute or chronic. It is accompanied by a discharge of a serous, mucous, mucopurulent, or purulent nature, often of offensive odor. In some cases the mucous lining of the antrum furnishes no secretion, the symptoms being caused by the swelling of the mucous membrane.

Etiology.—Acute inflammation of the maxillary sinus often accompanies acute rhinitis and influenza. In influenza the discharge is frequently purulent and the inflammation more severe than in simple acute rhinitis.

The acute infectious diseases—pneumonia, typhoid fever, measles, scarlet fever, diphtheria, and small-pox—often give rise to acute inflammations of the antrum. Inflammatory disturbances in the neighborhood of the maxillary sinus are liable to involve it by extension; this is especially the case in disease of the teeth of the upper jaw. Decay opens the pulp-cavity, clearing the way for infectious germs to follow the root canals to the periosteal lining of the socket of the root of the tooth. Here an abscess may form around the root, and if the lamella of bone separating it from the cavity of the antrum be thin, or, as in some cases, even wanting, infectious material may readily penetrate into the maxillary sinus, setting up an acute inflammation. It is not necessary, however, that pus should actually enter the antrum from the root abscess. The septic inflammation may travel through the bone, which becomes inflamed as a sequel to the periostitis. In this way a tooth whose socket is not situated under the antrum—as, for instance, an incisor tooth—may excite empyema by causing osteitis of the alveolar process; similarly, periostitis or osteomyelitis of the upper jaw from other causes may give rise to empyema of the antrum. Disease of the roots of the first and second molars is most liable to be followed by sinuitis, as the bony covering between them and the sinus maxillaris is apt to be thinner than in other places. The third molar and first bicuspid rank second in their liability to originate antrum disease. In rare cases the antrum extends as far as the cuspid tooth. In children the germs of the second teeth separate the bottom of the antrum widely from the teeth of the first set until second dentition, and up to this period empyema of the antrum is practically unknown. Root abscesses are generally accompanied by absorption of the bone about them, a process which favors penetration by infectious material of the tissues separating them from the antrum.

periosteum where the cheek joins the upper jaw, in a line above the prominences caused by the roots of the teeth, and extending from the canine to the second molar tooth. The mucous membrane should then be pushed upward and the bone exposed. If there be an empty space between two

FIG. 139.



Ingals's drainage-tube for antrum. Full diameter; three different lengths.

teeth or one can be created by the extraction of a root, or if there be a canal already drilled through the socket of a tooth into the antrum, the incision should be prolonged in this space to the free edge of the alveolar process. The antrum is then entered by means of a chisel one-half an inch wide, care being taken to keep well above the roots of the teeth, so as not to open the socket of a tooth. The opening is next enlarged upward and laterally by means of small bone rongeur forceps until the little finger can be passed into the antrum. This may be employed to search for foreign bodies, tumors, carious bone, projecting roots of carious teeth, displaced wisdom teeth, and other causes of chronic suppuration of the antrum. The cavity may also be inspected by means of the laryngeal reflector. Granulations are found only in the neighborhood of the canal that has been bored through the alveolus or where there is carious bone, as the epithelial surface of the mucous membrane remains, as a rule, intact. The excrescences and oedematous folds of the mucous membrane should be scraped away with the sharp spoon, while septa can be broken down in the same way. The bleeding is severe. After curettement the cavity should be packed with iodoform gauze or gauze impregnated with iodol or bismuth. The packing must not be done tightly, lest it cause inflammatory reaction. When the morbid process has had time to improve, after some days the antrum should be again inspected and palpated, and any remaining diseased tissues scraped away. This should be repeated from time to time until the cavity has ceased to discharge for some weeks. It is then safe to let the opening close. It is often difficult to keep it open, and the patient should be instructed to pass bougies into it to insure its patency.

In the Caldwell-Luc operation the opening in the anterior wall of the

FIG. 140.



Cysts and polypi in the antrum of Highmore. (Heymann, after Luschka.)

antrum is immediately closed by sutures after the cavity has been curetted and treated with zinc chloride, while an opening is made into the lower meatus of the nose for further treatment. It does not seem advisable to exchange the ready access to the cavity of the antrum and the prolonged control of the processes there offered by the opening in the anterior wall for the difficult approach furnished by an orifice in the inferior meatus, even if this be made large by the resection of the lower turbinal, especially when one considers how obstinate suppurations of the maxillary sinus are, and how prone to return after apparently being cured. The chief advantage offered by the Caldwell-Luc operation is the freedom from danger of food entering the antrum.

In cases of acute sinusitis of the maxillary sinus, if the symptoms be severe and lead the surgeon to suspect a collection of pus in the cavity, an opening may be made in the location mentioned by means of a trephine one-fourth of an inch in diameter, having a small drill in its centre as a guide. After the cavity is entered in this manner it should be washed out with a solution of protargol, from twenty to thirty grains to the ounce. The canal thus made should be allowed to close of its own accord, no drainage-tube being employed.

The fourth method of opening the antrum is through the inferior meatus with resection of the inferior turbinal. The anterior half of the turbinal is removed with the scissors and snare, and an opening five-sixteenths of an inch in diameter made with the trephine or trocar. This can be enlarged still more if needed. Without the removal of the anterior part of the turbinal the opening is very hard to find. This method is suited to those cases in which the teeth are perfect and the disease not of too obstinate a type. It does not drain as well as an opening through the alveolar process, as the floor of the antrum is generally lower than that of the nose.

Tumors of the Antrum of Highmore.—The *benign* tumors originating in the antrum are mucous polypi, which are hyperplasias rather than true neoplasms, and papilloma, fibroma, angioma, and osteoma. All of these are extremely rare growths. Of these neoplasms the one of greatest importance is the osteoma, which may occur as a free growth unattached to the bony walls of the antrum. In this form it is generally solitary, very slowly increasing in size until it fills the cavity of the maxillary sinus, causing its distention until its walls form a thin bony shell. Ivory or spongy exostoses also occur, and the latter may be of sufficient size to crowd on the orbit and cause exophthalmos.

The *malignant* tumors of the antrum are sarcomata and carcinomata. They are very rare, the former presenting as round-celled sarcoma, cysto-sarcoma, and fibrosarcoma. Early in their growth these tumors cause empyema of the antrum; later they distend its walls, which may become so thin as to crackle under the pressure of the finger; while at a still later period sarcoma perforates the antrum and extends to other tissues.

Carcinoma is generally found in the form of epithelioma, and many of these take their origin from the abnormal nests of epithelium occasionally found at the roots of the teeth. Those originating in other parts of the antrum are far more rare. The first symptom of carcinoma of the antrum is severe toothache that persists in spite of treatment or extraction of teeth. Neuralgias in the infraorbital nerve accompany that of the superior dental nerve. As the disease invades the alveolar process, hard palate, and anterior antral wall it causes protuberances and abscesses. Empyema of the antrum with very fetid discharge may occur early. When the antrum is opened or as the growth perforates its walls the nature of the disease becomes apparent. The prognosis is absolutely bad, as the tumor always invades the tissues extensively before it is discovered.

Symptoms of diagnostic importance are severe local neuralgias in the superior dental and infraorbital nerves, and anæsthesias when the growth has destroyed sensory nerve branches. Aspiration early in the disease is negative, while transillumination shows pupil and cheek to be dark. A suspicion that a growth exists within the antrum is a warrant for an extensive opening in the anterior wall of the cavity for the purpose of exploration.

CHAPTER XIII.

INFLAMMATION OF THE ACCESSORY SINUSES OF THE NOSE.

INFLAMMATION OF THE FRONTAL SINUS.

Synonyme.—Sinuitis frontalis.

THE frontal sinus is in intimate relation with the foremost of the anterior ethmoidal cells, which form neighboring chambers separated from it merely by thin bony walls; therefore inflammation of the frontal sinus almost invariably involves some of the ethmoidal cells.

Etiology.—The commonest cause of acute frontal sinuitis is acute coryza, of which it is a rather frequent accompaniment, especially in that form of acute rhinitis occurring with influenza. The acute infectious diseases may lead to inflammation of the frontal sinus. Injuries to the frontal sinus perforating its walls or causing subcutaneous fractures of them may cause the sinuitis, as also foreign bodies which find lodgement in the cavity. Bullets are especially prone to get into the frontal sinus and set up inflammation.

Chronic inflammation of the frontal sinus is apt to result from the acute form, especially when the natural opening of the cavity is narrow or the upper part of the infundibulum contracted or encroached upon by a middle turbinal crowded over by a deflected septum or by some other cause. Inflammatory swelling or hyperplasia of the mucous membrane of the outlet of the frontal sinus or its neighborhood may cause obstruction. Disease of the anterior ethmoidal cells, in addition to that of the frontal sinus, is apt to lead to obstructive hyperplasia and polypoid growth of the mucous membrane in the infundibulum and middle meatus, causing a chronic blocking of the outlet of the frontal sinus. Simple and malignant growths in the sinus may cause its inflammation.

Pathology.—Frontal sinuitis occurs in the acute and chronic forms. Acute inflammation is characterized by inflammatory oedema of the mucous surface, at times extensive enough to fill the entire cavity of the frontal sinus. The accompanying hyperæmia may lead to ecchymoses. The discharge is purulent or mucous, and has been found to contain the pneumococcus, staphylococcus pyogenes aureus, and diphtheria bacillus. The presence of the influenza bacillus has not been positively determined.

In chronic inflammation the mucous membrane in the more recent cases is swollen and hypertrophied, either smooth or displaying polypoid swellings and irregularities, or even polypi. The color of the mucous surface varies from pale pink to red. The epithelial covering is generally

found intact. Later in the disease the mucous membrane becomes more dense and fibrous.

Symptoms.—The most marked symptom of sinusitis frontalis is pain, which varies from a sense of weight in the region of the sinus to an intense aching, radiating to the eye and other portions of the head. The sensations are of a throbbing nature, and the pain is increased by bending forward, coughing, sneezing, or by anything causing the veins to distend.

When the outlet of the sinus is stopped up, absorption of the air in its cavity takes place with the production of negative pressure, or the secretions accumulate until they produce hydrostatic pressure on the mucous surface. Both of these conditions are probable causes of the pain, which is often much relieved by anything freeing the way to the sinus. The pain is apt to be periodic and worse in the morning, gradually improving during the day, as sneezing, posture, and blowing the nose tend to free the outlet of the cavity and enable it to discharge its contents.

The pain may be mistaken for that caused by supra-orbital neuralgia, and is apt to appear at nine or ten o'clock in the morning. Other symptoms are dizziness, heaviness, dulness of mind, and moderate fever. Ocular symptoms may occur, such as photophobia and lachrymation. Œdema of the upper lid and forehead appears in rare instances. The disease lasts a week or two, and may end suddenly with free discharge and great relief. Some cases become chronic, others show a decidedly septic tendency, the suppuration extending by continuity or perforation to neighboring regions. The carriers of the infection are often septic thrombi in the veins perforating the bone. An abscess may thus form in the orbit at its upper inner angle, displacing the eye, or abscesses may appear on the anterior surface of the sinus, or in grave cases suppuration may penetrate its posterior wall, causing subdural abscess, abscess in the frontal lobe of the cerebrum, meningitis, and pyæmic thrombosis of the longitudinal sinus.

In chronic frontal sinusitis the pain is much like that in the acute form, but is seldom as severe, and, instead of lasting but a few days, exists with varying intensity for months or years. Some patients have pain only during acute colds in the head. In the milder cases there is merely a feeling of weight in the region of the sinus, in others there is more or less severe headache, located in the frontal region and, as in acute sinusitis, worse in the morning. Physical exertion, eating, and the use of alcohol add to the pain. The patient is disinclined to physical or mental work, and depression of mind may exist even to the extent of melancholy. There is inability to concentrate the thoughts or to comprehend readily. Some patients are extremely nervous, others weak, depressed, and neurasthenic. Functional ocular disturbances may be present: photophobia, the appearance of a mist before the eyes, diminished acuteness of vision,

and lessening of the visual field. The pus flows from the frontal sinus into the infundibulum and appears in the middle meatus together with that from the anterior ethmoidal cells, if these be also diseased, as they generally are. The amount of discharge is less than in disease of the antrum, and is usually not fetid.

Dilatation of the frontal sinus is probably the result of its distention by retained secretions following chronic obstruction of its outlet. The dilatation may become apparent from two to twenty-five years after the beginning of the sinusitis, and the character of the retained secretions may be serous, mucous, purulent, or mucopurulent. The orbital, cerebral, and frontal walls of the sinus seldom protrude equally; usually one yields to the pressure sooner than the others, until the bone becomes so thin that it crackles under the finger and in some places disappears entirely, permitting the mucous lining of the sinus to be forced through it like the sac of a hernia. In this manner the inner wall encroaches on the cranial cavity, making pressure on the frontal lobe,—a condition which, however, causes no cerebral symptoms. Protrusion of the orbital wall dislocates the eye downward and outward, limiting its motions and in rare cases producing diminution or loss of vision. Protrusion of the anterior wall of the sinus usually accompanies that of the orbital wall; the latter, being thinnest, yields first. The size of the distended sinus may reach that of a pigeon's egg and in rare cases has attained the dimensions of a fist. Dilatation of the frontal sinus as the result of chronic inflammation is rare.

Chronic frontal sinusitis is liable at some time during its course, perhaps after years, to result in ulceration of the mucous membrane with consecutive periostitis and necrosis. This is generally the result of some acute exacerbation of the disease. Either as a consequence of the necrosis or by way of the perforating veins of the bone the suppurative process may extend beyond the sinus. In this manner abscesses may form on the forehead over the sinus, leading at times to fistulæ that penetrate its cavity.

When the process extends through the orbital wall, in most cases the result is the formation of a localized abscess that bursts through the upper lid, producing a fistula. In severer cases the eyeball is dislocated downward and outward by the swelling, its motions and those of the upper lid limited, while vision may be diminished or lost. In the worst cases there are phlegmonous inflammation of the entire orbit, thrombosis of the ophthalmic vein and consecutive thrombosis of the cavernous and petrosal sinuses, and pyæmia. The entire upper and inner wall of the orbit may become necrotic. In cases in which the septic process penetrates the posterior or cerebral wall of the sinus there may be subdural abscesses, meningitis, abscess of the frontal lobe, thrombosis of the longitudinal sinus, and pyæmia. Those forms of chronic sinusitis which tend to abscess formation are characterized by

intensity of pain and fetor of discharge. These symptoms may extend over long periods of time before the suppuration involves regions beyond the sinus.

Diagnosis.—The most characteristic symptoms of inflammation of the frontal sinus are pain localized in the region of the cavity and tenderness on pressure over its anterior and orbital walls. The various methods of intranasal examination may lead to a diagnosis. The middle turbinal can be sprung aside towards the septum by means of Killian's long, narrow bivalve speculum for rhinoscopy of the middle meatus; this may enable one to see the discharge as it flows from the sinus beneath the anterior end of the middle turbinal. Cocaine must be applied previous to this examination. In acute sinusitis probing or irrigation of the sensitive parts is best omitted, but in chronic disease attempts can be made to

FIG. 141.



Probing the frontal sinus. (Heymann, after Lichtwitz.)

probe the sinus through its natural opening. This is possible for experts in about fifty per cent. of the cases. When the sinus opens underneath the anterior end of the middle turbinal in front of the processus uncinatus and hiatus semilunaris, the passing of a probe into the sinus may be surprisingly easy; when it opens into the upper part of the hiatus semilunaris it may be impossible to probe the sinus. If the frontal sinus opened by a simple foramen, it would be very easy of entrance, but as access to it is gained by means of a canal that is generally five-eighths of an inch in length and may be tortuous, it is often a hard matter to probe it.

No exact curve can be suggested for the probe, as it must be bent to suit the case. As a general rule, however, a probe with a curve three

inches in length, having a depth or radius of one and three-sixteenths inches, is the best to begin with. In some cases it is well to bend the end of the probe at a right angle to its shaft and give the extremity a length of three-quarters of an inch. The canal of the outlet of the sinus must be entered from behind, as its normal direction is downward and backward. The probe should be gently inserted as high up as possible underneath the anterior end of the middle turbinal before its handle is lowered to give its extremity the necessary direction upward and forward. It is difficult to tell to what length the probe has entered, and whether it is in the sinus or detained in its outlet. For this reason Killian uses a second probe which has exactly the curve of the one passed into the sinus. This he places against the face in a position corresponding to that assumed by the probe in the naris, and estimates the depth to which the first probe has entered the sinus by means of the one held externally. If the probe enter two and one-half inches, as measured from the nasal entrance, it is probably in the sinus. Removal of the anterior end of the middle turbinal in the manner mentioned in the previous article (page 369) will greatly facilitate probing, but even here anatomical conditions may prevent it.

Probing may be followed by irrigation or insufflation of the sinus to wash or blow out the secretions as an aid to diagnosis, and for this purpose a fine tube of the same curve as the probe is introduced. When the sinuses communicate, discharge can be made to appear in the other side of the nose by irrigation or insufflation. For diagnostic purposes a trocar or Palmer's frontal sinus drill may be passed under the middle turbinal and made to enter the sinus, or the trocar may be forced into the sinus by passing it between the septum and middle turbinal and piercing the latter at its base. The proceeding is, however, not without danger, and some advise against it, as there is risk of piercing the cranial cavity through the posterior wall of the sinus. Transillumination is used for diagnostic purposes, but the results are very uncertain. A rubber cylinder with an aperture one-half of an inch in width is slipped over the light and pressed firmly against the upper inner wall of the orbit just behind its free border. Under these conditions thickening of the mucous membrane or pus in the sinus may cause a shadow. Ocular disturbances are to be carefully searched for.

If it be impossible to arrive at a diagnosis by intranasal methods, the sinus may be opened from in front by a small incision in the eyebrow and by drilling through the anterior wall with the dental engine. An aspirating needle may be passed through the opening and secretion withdrawn, or fluid injected and withdrawn for diagnostic purposes.

Prognosis.—Most cases of acute sinusitis recover, a small number become chronic, and in very rare instances the septic process extends beyond the sinus, causing serious complications. Chronic inflammation of the frontal sinus probably does not spontaneously recover. Removal

of obstructions to the outlet of the canal will often suffice to stop the headache and ocular disturbances, so that the patient is satisfied, even if the sinus continue to discharge moderately. Operative interference may bring about recovery in the more severe cases, but often this has to be of a most radical nature. When the suppuration extends to the cranial cavity the result is usually fatal.

Treatment.—Acute catarrh of the frontal sinus as ordinarily seen yields to the measures employed for the acute coryza causing it. The septic form, causing abscess of the orbit, requires the opening of the sinus from the front. When there are intracranial suppurations, radical operations involving the opening of the cranial cavity are required; these belong properly to general surgery.

In the treatment of chronic inflammation of the frontal sinus the first aim must be to free the outlet in the nose from obstructing hypertrophies or polypi. If the sinus be readily accessible, irrigation may bring about recovery. For this purpose a saturated solution of boric acid or normal salt solution is a useful fluid. In most cases it is necessary to remove the anterior part of the middle turbinal and the processus uncinatus

FIG. 142.



Palmer's frontal sinus drill.

in the manner described in the preceding article. This gives better access to the opening of the sinus, which may be enlarged with the Grünwald-Hartmann forceps with upturned cutting beak, or the sinus may be entered with the Palmer drill in the manner described above. When there is decided distention of the sinus, making its entrance easy, a trocar resembling Krause's antrum trocar may be employed, through which a drainage-tube may be passed into the frontal sinus. To introduce the drainage-tube here recommended in such a case, the tube, funnel end uppermost, should be passed over the end of a copper wire, slightly roughened to prevent slipping. The tube should then be tied fast to the wire near the end by a strong silk thread in a bow-knot that can easily be untied by pulling on the long ends of the thread which hang from the nostril. With a cambric needle a strong silk thread is passed through the flange at the opposite end of the tube, close to the opening, so that it cannot tear out. This thread should be about two feet long, and both ends will hang out of the nose when the tube is introduced. The tube, now being well soaped so that it will slip easily, is pushed by the wire to which it is tied through the canula into the frontal sinus

and the canula then withdrawn. The ends of the thread that ties the rubber tube to the copper wire are then pulled upon and the thread brought away. The copper wire is next withdrawn, leaving the rubber tube projecting into the frontal sinus, with the thread attached to its lower end. Lastly, with a good illumination of the nasal cavity, this thread is steadily pulled and the tube drawn down until the flange just escapes from the opening left by the trocar into the upper part of the nasal cavity. One end of the thread is now cut and, with a probe pressed against the end of the rubber tube to keep it from slipping, the thread is withdrawn, leaving the drainage-tube in position. When, because of anatomical difficulties, the sinus cannot be entered from the nose, or when there is already a fistula in the orbit or on the forehead, or when fetid discharge indicates ulceration and necrosis of bone, the sinus should be opened from without. This should also be done in septic cases with abscess formation about the sinus and in cases with dilatation of the sinus. The incision should be made within the eyebrow along its lower border, and extend from its middle to the centre of the nasal bridge and across, if needed. The lower flap should be pushed down, exposing the edge of the orbit, while the upper border is pushed up with the periosteum. The sinus should then be opened near the angle of the orbit with drill, trephine, trocar, or chisel. The opening should be large enough to admit the end of the little finger for thorough exploration. The cavity should be cleaned out and curetted, if necessary. If pus exist in the opposite sinus, the septum must be broken down so as to allow free drainage. The sinus should then be thoroughly irrigated with a bichloride or other antiseptic solution, and communication with the nose re-established. This may be done by pushing a trocar through the frontonasal canal into the nasal cavity, guided by the little finger, which has been introduced into the nostril of the corresponding side. Krause's antrum trocar is well adapted for this purpose. A slightly funnel-shaped rubber tube is then passed through this opening from the frontal sinus to the nasal cavity, where it is allowed to remain until suppuration has ceased; the tube may then be withdrawn through the naris. In this operation the external wound may sometimes be closed at once, or it may be packed with iodoform gauze and kept open for a time, if necessary. The cavity must be washed from time to time and in some cases daily until suppuration ceases, which may be expected in from one to six months. The incision within the eyebrow will leave a scar that is hardly visible when it has been possible to secure prompt healing of the external wound. Finally, as

FIG. 143.



Ingals's frontal sinus drainage-tube. A, section of tube showing thinness of rubber at funnel, allowing it to be easily pulled out; B, showing flange at bottom to prevent escape of tube into frontal sinus.

recovery takes place the drainage-tube is removed through the nose. The chief danger, especially when the opening in the frontal bone has been made too small, is that the posterior wall of the sinus may be perforated by the trocar when the attempt is made to re-establish the opening to the nose, and in one case death has resulted from this accident. Ocular disturbances have also been reported after the operation.

There are many varieties of the operation. Removal of the anterior wall of the sinus, if extensive, is followed by sinking in of the skin and a disfiguring depression. To avoid this osteoplastic resection of the anterior wall of the sinus, including the rim of the orbit as far as the sinus extends, is performed, the bone flap turned up, and the interior of the sinus thus made very accessible.

When the extent of the disease requires it, Killian opens the sinus widely from in front, leaving the rim of the orbit, which can be accurately severed from the bone, to be removed by means of a circular saw driven by the dental engine. He then removes the orbital floor of the sinus from below and above with chisels and forceps, and, after curettement, continues the incision on the dorsum of the nose as far as the nasal bones extend, and, dividing these with a chisel and the nasal process of the superior maxillary with a saw, he turns this and the nasal bone outward as a flap. In this way he obtains direct access to the outlet of the sinus and diseased ethmoidal cells, which latter he removes, thus creating a broad opening between the sinus and the nose which is in no danger of closing by granulation, as openings made by the trocar are apt to do. The flaps are replaced at once, the cavity tamponed with iodoform gauze, and the wounds either sutured immediately or after two days. Other diseases of the frontal sinus come more properly within the domain of general surgery.

EMPHYEMA OF THE SPHENOIDAL SINUSES.

The sphenoidal sinus is a large cavity extending from a point about one-quarter of an inch back of the vomer in the nasopharynx forward to the cribriform plate of the ethmoid bone, so that a portion of its lateral wall forms the inner wall of the orbit at its deepest part just posterior to the body of the ethmoid bone. The sinus is divided by a septum into two cavities, often very unequal in size. The opening of each sinus is in the anterior wall, generally at its upper part. The opening in the bone is larger than that in the mucous membrane, the latter usually being of sufficient size to admit a stout probe.

Etiology.—Acute inflammation of the sphenoidal sinus is usually the result of acute infectious rhinitis. The deep seat of the cavity protects it from anything but extraordinary traumatic influences. Foreign bodies—in one instance a piece of straw—have been found in the sinus, and have excited inflammation. Chronic rhinitis, especially if purulent,

predisposes to sphenoidal sinuitis; it may also be an accompaniment of atrophic rhinitis, and in some cases doubtless precedes and causes it. Discharge from an inflamed frontal sinus may flow backward during sleep and infect the sphenoidal sinus, or this may become diseased secondarily as a result of inflammation of the ethmoidal cells, the infection spreading through their walls by continuity, perforation, or because the discharge enters the sphenoidal sinus.

Chronic inflammation of the sphenoidal sinus results from the acute disease. This is especially liable to be the case in scrofulous or syphilitic subjects, or people in whom nasal mucous polypi block the entrance to the sinus, or when chronic rhinitis lowers the recuperative powers of the nasal structures.

Pathology.—The changes due to acute or chronic inflammation of the mucous lining of the sinus are the same as those found in disease of the antrum or frontal sinus, and have been described with those affections. Polypi have been found in the cavity of the sphenoidal sinus, and in chronic cases the bone may become carious or necrotic.

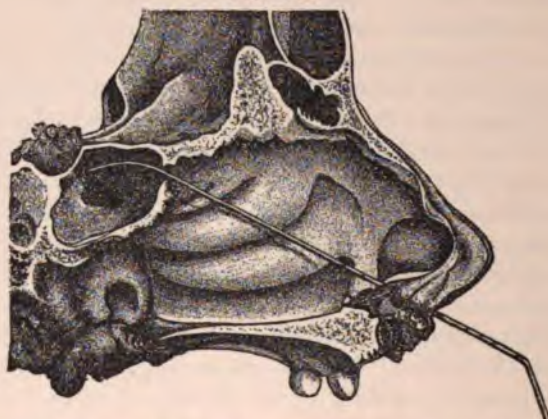
Symptoms.—As in inflammation of the other sinuses, pain is the most marked symptom of the disease in both the acute and chronic forms. In the *acute* variety there is generally a history of a severe cold accompanied by an almost unendurable pain in the forehead, occiput, and deep in the skull. A feeling of pressure from behind is felt in one or both eyes, accompanied by dizziness. The pain is due to pressure on the sensitive nerves of the sinus on account of the swollen mucosa and retained secretion, and lasts much longer than that accompanying a common cold, which it also greatly exceeds in severity. Inspection shows great swelling of the deeply reddened mucous membrane between the middle turbinal and septum, so that the olfactory region is closed, the mucous surfaces being in contact. The mucous covering of the anterior wall of the sinus is also swollen and protrudes, while the orifice is often closed by the swelling. In acute sinuitis the discharge is slight and usually mucopurulent. It appears in the region of the tuberculum septi, or exuding from the olfactory fissure between the middle turbinal and the septum, or flowing back into the nasopharynx.

In *chronic* inflammation of the sinus the patient complains of the abundant discharge, which appears in the form of crusts or pus in the nose or nasopharynx, whence he hawks the secretion with difficulty. He may notice that the discharge has a foul odor, though this may not be appreciated by others. Anosmia and disturbance of taste occur, these symptoms being due to the closure of the olfactory region. Dizziness, supra-orbital neuralgia, pain in the centre of the head, and stiffness of the nape of the neck are prominent symptoms. They are often intermittent, and when severe may lead to nausea and vomiting. The pain is usually in the same region. As in disease of the other sinuses, marked cerebral symptoms accompany the ailment,—viz., hebetude, forgetfulness,

and depression amounting to melancholy. The pain, the chronicity of the affection, and the annoyance of the often fetid discharge discourage the patients greatly. They look miserable and cachectic, and functional eye disorders occur.

When nasal mucous polypi and hypertrophic rhinitis accompany the disease they interfere with the patient's breathing, while the crusts help to block the nares. Inspection shows the root of the nose in some cases to be slightly swollen and broader than normal. The nasal interior presents the changes due to chronic rhinitis, while the tuberculum septi, which is the normal thickening of the mucous membrane of the septum opposite the anterior end of the middle turbinal, and the middle turbinal itself are hyperplastic and generally hidden by a crust, underneath which is a layer of fluid pus. Pus can be seen exuding from the olfactory region between the middle turbinal and the septum. Inspection of the

FIG. 144.



Probe passed into sphenoidal sinus through the natural opening. (Lichtwitz.)

nasopharynx shows thin crusts adherent to the vault of the pharynx, the septum, and the choana on the side of the diseased sinus. Fluid pus can also be seen running down the lateral wall of the choanæ.

Diagnosis.—In order to reach a diagnosis in acute sinusitis it is necessary to make the sinus accessible, and for this purpose in many cases the surgeon must remove the anterior end or all of the middle turbinal in the manner described in the diagnosis of empyema of the antrum. In other cases it is possible to pass a probe into the sinus without this preliminary operation. The probe used should be stout and stiff, three-thirty-seconds of an inch in thickness, and bent nearly at a right angle to its handle to avoid having the hand holding it interfere with vision. If the probe be passed from the lower border of the nostril upward and backward across the centre of the middle turbinal parallel to the septum, it will reach the anterior wall of the sinus. When this is softened by disease, the probe

will readily enter the sinus by its normal entrance or by perforating the mucous membrane and softened bone. The probe may suddenly slip through the opening, or the thin plate of bone may be felt to give way as it is punctured. After the probe has entered, the patient should be told to press the opposite nostril shut and blow forcibly through the one on the side of the diseased sinus, when pus and blood will be aspirated by the blast into the naris. This generally gives him immediate relief,—a matter of diagnostic value. In making the diagnosis of chronic sinusitis the examiner must go through the same procedures, being careful to exclude or recognize coexisting disease of other sinuses. Carious bone will give its characteristic grating sensation to the probe.

Prognosis.—Many cases of acute sinusitis recover spontaneously, but have a tendency to recurrence, and some become chronic.

Chronic inflammation shows no tendency to spontaneous recovery. It seldom threatens life, but serious complications, though rare, may occur. Caries and necrosis of the body of the sphenoid, or spreading of the septic inflammation through the bone, may cause a deep-seated orbital suppuration with optic neuritis, blindness, and later fatal meningitis. Fatal hemorrhage due to perforation into the cavernous sinus, sinus

FIG. 145.



Spoon-shaped probe of Max Schäffer for entrance into sphenoidal sinus.

thrombosis with thrombosis of the ophthalmic vein, destruction of the sphenopalatine ganglion, and brain-abscess are among the possible occurrences.

Treatment.—The treatment of acute and chronic empyema of the sphenoidal sinus is essentially the same, the most important object being free opening of the cavity for drainage. As a preliminary it may be necessary to cut away the anterior part or all of the middle turbinal, and hypertrophies or polypi must be removed. Mere probing of the sinus does not insure a sufficient opening, so that the probe should be immediately followed by a small, sharp spoon, with which the anterior wall must be broken down in a downward direction as far towards the floor of the sinus as possible. One of the larger Grünwald sharp spoons is an instrument well suited for this purpose. The loose fragments of bone and such portions of the lower part of the anterior wall as are too thick to yield to the curette should then be cut away with nasal bone-forceps to the floor of the sinus. The floor of the cavity can also be entered from below by way of the nasopharynx with Ingals's diamond drill trephine driven by the dental engine; the trephine is attached to the engine by means of a right-angle attachment for the chuck. The cavity can be penetrated from in front by a trocar or long trephine.

Artificial openings into the sinus show a strong tendency to contract rapidly, and therefore should be made as large as possible.

These proceedings give drainage at the lowest point, and may be followed by irrigations and insufflations of iodoform powder. Hemorrhage is sometimes severe, but can usually be checked by irrigation with a one per cent. solution of citric acid. When the bleeding stops it is well to treat the interior of the sinus with a fifty to eighty per cent. solution of trichloroacetic acid, applied with a swab; this cauterizes diseased mucous surfaces and reaches places that cannot be scraped with the curette. The anatomical location of the sphenoidal sinus prevents the sharp spoon from reaching more than a limited part of its area. Necrotic or carious bone is generally situated near the outlet, and can, therefore, be removed with the curette or taken away with nasal bone-forceps.

FIG. 146.



Bone-forceps of Max Schäffer for opening the sphenoidal sinus.

After completion of the operation, iodoform or iodol gauze should be packed against the sinus to stop bleeding or to prevent its recurrence. The plug should be left in place for two days.

Carious or inflamed bone is exquisitely sensitive, and when this is removed thorough and repeated applications of cocaine are needed. After the operation the patient often has prompt relief from pain and headache; in other cases this comes gradually. The mental symptoms also disappear together with the swelling of the bridge of the nose. If the operation be thoroughly done at the first sitting, it is seldom necessary to do anything further. It is well, however, to keep the nasal cavity clean by means of sprays or irrigations.

SUPPURATIVE ETHMOIDITIS.

The ethmoidal cells form a connecting chain in the continuous row of air-cells that extends from the frontal to the sphenoidal sinus. Their outer covering, the lamina papyracea, forms a large part of the inner wall of the orbit. They project into the nose in its upper portion on each side of the septum, while the upper and middle turbinals jut down-

ward from their lower surface. The bone covering the ethmoidal cells and forming the partitions separating them from one another and from the frontal, sphenoidal, and maxillary sinuses is of shell-like frailty. An ethmoidal cell, at times of large size, is found in the anterior part of the middle turbinal.

Etiology.—Ethmoiditis is in many instances secondary to sinus disease elsewhere. Sinuitis of the frontal sinus can hardly exist without involving the anterior ethmoidal cells. Suppuration of the antrum may extend to the ethmoidal cells through the thin bone of this cavity either by caries and perforation or by continuity of inflammation through the bone or its venous orifices. In a similar way disease of the sphenoidal sinuses may pass through the thin lamina of bone separating them from the posterior ethmoidal cells. Pus from suppurating sinuses may enter the ethmoidal cells through their orifices and infect them in this manner.

The other causes of ethmoiditis are the same as those of inflammation of the sphenoidal sinus.

Pathology.—The thin bone forming the wall of an ethmoidal cell is softened and inflamed as a result of the suppurative process, as is the case with the plates of bone forming the outlets of the frontal and sphenoidal sinuses. This condition makes entrance to a diseased cell or sinus easier than to a normal one. The mucous lining of the ethmoidal cells undergoes the changes usual to sinus disease and described in the preceding articles. The large area of their lining, together with their imperfect drainage, gives a reason for the great amount of pus that in many cases flows from their interior. Proper drainage soon cuts short the suppuration.

Symptoms.—The pain caused by suppuration of the ethmoidal cells is perhaps more intense than that due to disease of the other sinuses; it is not sufficiently characteristic, however, to distinguish it from pain originating in these other cavities. It is felt at the root of the nose, the lower inner part of the orbit, the upper part of the cheek, and the region of the frontal sinus. The pain may be intermittent in character and last for some time before there is a discharge of pus from the nostril.

Nasal respiration becomes blocked and the swollen middle turbinal interferes with the sense of smell, the mental symptoms are like those of disease of the other sinuses, and the secretion of pus may be scanty or very abundant. Pressure on the lachrymal bone or on the root of the nose may intensify or bring on the pain, and inspection at times shows œdema of the root of the nose, the infraorbital region, or the cheek. The bridge of the nose may seem abnormally wide, and in some cases, when the cells of the ethmoid labyrinth are distended, they bulge into the orbit, causing swelling at the inner canthus, with displacement of the globe outward and diplopia. This may be the first symptom that brings the patient to the surgeon. When the anterior ethmoidal cells are involved, pus will appear in the middle meatus, coming from the hiatus semilunaris; when

the posterior cells are diseased the pus appears in the olfactory region, between the middle turbinal and septum, and also flows back over the body of the sphenoid into the nasopharynx, appearing on its vault and in the choana in the form of tough flakes or crusts.

The intimate relation of the middle turbinal to the ethmoidal cells, jutting as it does from the bony covering of their lower portion, causes it to suffer greater pathological changes than occur in disease of the other sinuses. If one or more of the ethmoidal cells enter its base they distend within the turbinal, at times greatly expanding it. Its mucous surface is often covered with polypoid excrescences, and the turbinated bone itself becomes softened and inflamed. Pus may exude from its base, and may be seen to ooze from all sides of it when it is moved with a probe. The pus is often fetid, but seldom markedly so. In some cases the objective signs are insignificant and the discharge of pus slight.

Diagnosis.—In those cases in which the discharge is profuse and the disease pronounced the diagnosis presents less difficulty than in those in which the objective signs are but slightly marked, the discharge insignificant, and the affection limited to one or two cells.

As in disease of the other sinuses, the probe is the most important of diagnostic aids. It should be bent according to the anatomical conditions present, but a probe with its extremity bent at an obtuse angle is the most generally useful. In the search for disease of the posterior ethmoidal cells the probe should be passed up in the olfactory region between the middle turbinal and septum; the anterior cells may be reached by inserting the probe into the middle meatus, and passing it underneath the middle turbinal back to the hiatus semilunaris. If, in the search for the posterior cells, the probe be passed up directly along the septum it will miss them and touch the cribriform plate, and therefore it should be kept close to the middle turbinal, while the extremity of the probe is directed outward at an angle of about forty-five degrees. The cells are to be found at the posterior end of the middle turbinated body, and hence the probe must be passed sufficiently far back to reach them. As in empyema of the other sinuses, the middle turbinal is the structure most in the way of the probe or other instruments, and may need removal at its anterior extremity or for its whole length before it is possible to diagnose or treat disease of the hidden ethmoidal cells. In probing them it is generally necessary to break through their bony walls; the probe, therefore, should be of stiff material and three-thirty-seconds of an inch thick. It is not well to be too hasty in the diagnosis of caries of the bone, as the rough edges of the fractures left in pushing a way into the cell may be taken for dead bone. The probe passes readily through the bone where it is softened by inflammation, while sound bone will offer a good deal of resistance. Probing a diseased cell may elicit the characteristic pain felt spontaneously by the patient at other times.

Prognosis.—The great number of cells forming the ethmoidal labyrinth causing hidden foci of suppuration that are badly drained, if drained at all, and the dangerous region they occupy making vigorous operative interference risky, render the prognosis as to rapid recovery less favorable than in disease of the sphenoidal sinus. The disease may extend over many years, and in some patients nothing more than improvement of the condition may be expected. Grave complications are rare, though orbital abscess, with the serious consequences mentioned as resulting from sphenoidal or frontal empyema, meningitis, abscess of the brain, and emphysema of the cellular tissue of the orbit, may occur. Necrosis of large parts of the body of the ethmoid or of its cribriform plate, hemorrhages, and cerebral suppurations are usually results of the disease when caused by syphilis.

Treatment.—The introduction of the probe can immediately be followed by that of the sharp spoon. This should take the same direction as the probe. To reach the anterior cells it must be passed upward and backward between the middle turbinal and outer nasal wall, and to reach the posterior cells, upward and backward along the inner surface of the middle turbinal and also behind this bone. It may be necessary to remove the middle turbinal wholly or in part in order to make the ethmoidal cells accessible. If the entire middle turbinal is to be removed, this is best done with strong nasal bone-forceps; Pynchon's forceps are well suited to this purpose. Dead and carious bone may be scraped away with the curette, and bony septa between the cells may be broken down with it or perforated with the drill or trephine, or cut away with bone-forceps. In the same manner polypoid and fungous masses may be removed. The sharp spoon or forceps finds less resistance from the inflamed and softened bone of the diseased portions than from the firm bone of the healthy parts, so that in a measure the sense of touch indicates to the surgeon how far to go. It should never be forgotten that instruments too vigorously used may penetrate the orbit or the cranial cavity. After all the diseased cells have been opened in this manner by breaking down their bony walls, the honeycomb-like ethmoidal labyrinth is transformed into a large irregular cavity the recesses of which can be felt rather than seen. The hemorrhage is often severe, and the operation may have to be interrupted to check it by temporary tamponing. When as much as possible of the diseased tissue has been removed, the interior of the cavity should be cauterized with an eighty per cent. solution of trichloroacetic acid, insufflated with iodol, and tamponed with iodol or bismuth lint, which should be removed after two days. Some favorable cases recover as a result of the first operation, but many drag on for months or years, improved but not well. Secondary operations are often needed, as some cells may have escaped opening at the first or subsequent interferences. Recurrences of the suppuration may take place as the disease lights up in cells not involved at first. If disease of the

antrum exist, it must be remedied before one can hope to cure that of the ethmoidal cells.

For after-treatment most satisfactory results may be obtained from injecting into the ethmoidal cells, with a long, slender silver cannula attached to a hypodermic syringe, fifty per cent. solutions of hydrogen dioxide or five per cent. protargol, and subsequently oily solutions containing oil of gaultheria one minim, oil of caryophyllum five minims, terebene ten minims, to one ounce of oleum petrolatum album, the strength being slightly increased or diminished according to the effect. They should not cause pain for more than half an hour afterwards. At the same time the nasal cavity should be washed two or three times daily with a detergent solution, and a similar oily preparation, or one somewhat weaker, may be used as a spray by the patient morning and evening. A powder containing five per cent. of aristol, two per cent. of cocaine, twenty per cent. of boric acid, and forty per cent. of iodol, with sugar of milk for an excipient, may advantageously be used by the patient once or twice daily as an insufflation.

CHAPTER XIV.

DISEASES OF THE NASAL SEPTUM.

DEFLECTION OF THE NASAL SEPTUM.

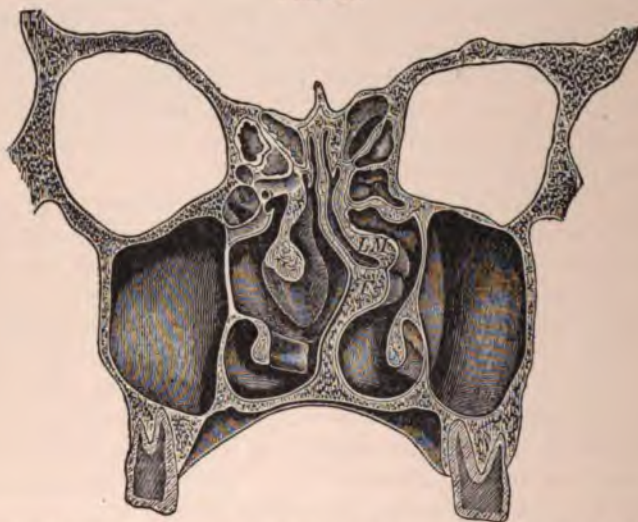
ALMOST all nasal septa bulge slightly into one or the other nostril, and a deflection becomes pathological only when it obstructs respiration. Deflection of the septum is far more common among Europeans than other races of men. Septal deflection among negroes is said to be infrequent, and even the American Indian, with his aquiline nose, is not subject to it. The proportion of men to women with the deformity is about two-thirds for men and one-third for women. Septal deflections can be found at any age, and even new-born infants may present them. They are not uncommon in childhood, but, as a general rule, the septa of children are practically straight, and deflections do not become troublesome until adolescence.

Etiology.—Though a traumatic origin due to infraction of the septum as the result of blows on the nose is accepted by all authors, this is doubtless not as frequent a cause as many suppose, as the patient is inclined to attribute his trouble to some accident to his nose, however slight. The commonest cause of septal deflection is disproportionate growth of the septum and the bones that frame it. The upper jaw especially is apt to be asymmetrical. The septum will thus become too large for its setting, and as the individual grows this disproportion becomes sufficiently marked to cause it to buckle and fill one naris or obstruct both, as in the sigmoid form. That this disproportion may begin early the cases occurring in infants show. The septum may be forced over by nasal tumors, sometimes to an extreme degree; bony cysts of the middle turbinal may also accomplish this, but simple hypertrophy of the turbinals cannot displace the septum.

Pathology.—In simple deflection, whether of the bony or cartilaginous part of the septum, its thickness is even and normal throughout, the bone or cartilage being merely bent out of shape as one would bend a sheet of tin. The deflection of the osseous septum alone is rarely great enough to evoke symptoms, and most bony abnormalities large enough to cause obstruction are ridges, spurs, or exostoses. The posterior part of a cartilaginous deflection may extend back, however, so that the vomer and perpendicular plate of the ethmoid at their place of junction are involved in it and are bent out into the naris; in fact, a large proportion of cartilaginous deflections are carried back into the bony septum in this way, adding to the difficulties of their correction.

The quadrangular cartilage is the place in which deflections are seen oftenest and in their greatest development, and the variety of shape presented by these is so great that almost each case is peculiar. The degree of bulging of the septum varies from a slight amount hardly obstructing the air-current to protrusions that pack the bent septum tightly against the turbinals and close the naris completely. The opposite side of the septum shows a hollow corresponding to the elevation on the obstructed side. In some cases the deflected septum is curved into one nasal fossa in a single bend as seen from above or anteriorly; this is spoken of as the C-shaped form of deformity. In other cases the septum bends into one naris above and projects into the other below; this is called the S-shaped or sigmoid septum. Though no two deflections are

FIG. 147.



Transverse section through nasal cavity. (Bresgen.) *F*, deflection and spur which have prevented the growth of the middle turbinal; *LM*, left middle turbinal.

precisely alike, there are certain types that often present themselves. A common one occupies the front of the cartilaginous septum. The projection it causes is visible without a speculum, and usually presents as a wedge-shaped vertical angle like the corner of a box pointed across the obstructed naris. The upper part of this angular projection merges insensibly into the upper part of the septum, but the lower part may jut out prominently, as if the floor of the box joined the sides. The corner may be right-angled, or present an obtuse or acute angle. Instead of being vertical, it may extend up and back in the direction of the upper border of the vomer. In many cases the anterior surface of the corner stretches across the naris, closing it, while the posterior surface, instead of sharply receding to the normal plane of the septum within its car-

tilaginous part, is very long, and involves both the cartilaginous and bony septum, which take part in the deflection.

In another type of deflection the whole cartilaginous and often the bony septum are bent in a gentle curve, both vertically and horizontally, into the obstructed naris. Still another form, and a common one, shows the wall of the septum projecting into the other side, such as the finger makes in a tightly stretched cloth.

A peculiarity of many deflections is that their deepest part in the concave side forms a hollow with steep sides, which meet at the bottom at an angle, while a corresponding sharp projection is seen on the convex side. The corner-shaped type of deflection seems to be the commonest. After the deformity of the cartilaginous septum has been removed, there is often found a spur or ridge behind it corresponding to the upper border of the vomer, or this and the perpendicular plate of the ethmoid continue the deflection. In adults the average thickness of septal deflections is one-eighth of an inch, and the deepest and most prominent part of them usually has the thinnest walls. The lower part of the deflection is often thickened to as much as three-eighths of an inch. In women the septum is generally thinner than in men. *Ecchondroma*, *exostosis*, and abnormal thickening of the septum usually complicate the deflection.

A peculiar form of septal deformity is seen when the anterior part of the quadrangular cartilage has been dislocated from the superior maxillary ridge or even the vomer back of it. In this case the lower edge of the cartilage and its anterior inferior angle can be seen projecting into one nasal vestibule as a whitish, sharp ridge beneath the mucous membrane, while the other nasal fossa may be obstructed by a deflection above this, the anterior border of the septum thus lying across both nostrils.

Symptoms.—The symptoms produced by deflection of the septum are the usual ones of nasal obstruction, and they may appear only when an acute or chronic rhinitis causes swelling of the mucosa. A slight degree of the latter may then be enough to block the narrowest naris entirely. The time when deflections begin to produce obstruction is usually after the period of adolescence, when the osseous system is completing its development. Many patients, however, in middle life date the trouble due to their deflected septa back but a few years, even when a fracture has not occurred which could account for the deformity. In these cases a chronic swelling of the mucosa has usually developed. It is very common to find the turbinals in the naris containing the concavity in the septum hypertrophied, and in some cases to such a degree that

FIG. 148.



Deflection of anterior portion of septum in the right naris, with hypertrophy of the anterior end of the lower turbinal in the left.

the nasal fossa which normally would be the roomiest is the most obstructed.

Hypertrophic rhinitis and nasal mucous polypi are frequent accompaniments of septal deflection. The difficulty in clearing the obstructed naris of secretion during acute catarrhs causes these to be persistent, and leads to chronic hypertrophic rhinitis of the impervious and finally of the sound side of the nose. The obstacle to the air-current makes it difficult for patients to clear the nasopharynx of secretions, and post-nasal catarrh is a common complication. Middle-ear catarrh frequently accompanies septal deflection, and great difficulty may be experienced in passing the Eustachian catheter through the narrowed nostril, this often being impossible. Pressure of the deflection against the turbinals has in some cases caused their atrophy. Nervous symptoms and erythematous, papillary, and eczematous eruptions on the face have been attributed to the affection. Though these symptoms may have some connection with septal deflection, they certainly are rare complications of it. When the deflection is great, a prominent symptom is twisting of the nose to one side, usually opposite the convexity of the septum. The deformity is sometimes very marked from bending to the side of the anterior edge of the cartilage, even though there be but little deflection farther back. If the deflection be of sufficient degree, the voice will have the peculiar dead quality and lack of resonance due to nasal obstruction, and the change in its timbre after a successful operation is often very marked and pleasing. Inspection of the septum will show it extending across the obstructed nasal fossa more or less completely, so that often the parts back of the deflection are invisible. The concave side of the septum will present more or less of a depression, which at times is surprisingly deep. One may see the signs of hypertrophic rhinitis, but in a large number of cases the nasal interior looks healthy. The surgeon should not be satisfied with merely inspecting the deflection, but the posterior nares should be examined by rhinoscopy for obstructing hypertrophies of the posterior ends of the turbinals. The thickness of the septum can be judged by passing a little finger into each nostril, but a septometer will give more accurate results. It is an instrument resembling the calipers used for measuring the caliber of pipes.

Diagnosis.—There is no disease with which deflection of the septum is liable to be confounded if a careful rhinoscopic examination be made.

Prognosis.—Most of the evil results of the obstruction can be remedied by a suitable operation, and the external deformity may be largely removed if the nasal bones have not been crushed so as to cause depression of the bridge of the nose.

Treatment.—The numerous operations devised for straightening the deflected septum show that many of these have proved unsatisfactory and also how difficult the apparently simple task is. The varied forms in which septal deflection appears also account for the multitude of methods

needed to suit different cases. The difficulty of operation is also enhanced by the fact that most deflections are combined in varying degrees with exostoses and ecchondroses, so that often the deflection becomes a minor matter and the exostosis the chief object for operation. It is useless to devote space to anything but those means that are considered best to-day, and they are all operative.

Perhaps more employed than any other at present is the operation of the crucial incision through the septum. Though this method is commonly attributed to and named after Morris J. Ash, it was practised long before the present era, being in use in 1870. Ash has devised a set of instruments for its ready performance, and his writings have brought the operation into prominence in recent times. The reason for the popularity of this operation is that it does not require the skill that familiarity with rhinological manipulations can alone give, so that it can be performed by the general surgeon. It is largely mechanical, and does not necessitate much planning of the work to be done or minuteness and deftness in its execution. It is suitable for extreme and difficult deflections seated too far back within the nasal cavity to easily be reached from in front, but is by no means the only method for every form of deflection that many are trying to make it. It is a formidable operation for the patient, even if easy for the operator, as general anæsthesia is required, and the large and powerful instruments inserted within the nasal fossæ may do violence to the structures there.

Fractures of both the middle and inferior turbinals have been reported, with complete closure of the inferior meatus and adhesion of the lower turbinal to the floor of the naris as results. As usual where mechanical methods take the place of manual dexterity, they apply themselves perfectly to but a limited number of suitable cases; for the others operations especially planned for the case and performed with local anæsthesia are much better, and are not followed by the pain that the violent manipulations of the septum in the operation as performed by Ash cause the patient for the first day or two, nor do they require its tedious after-treatment or a stay in bed.

Those who wish to read an excellent presentation of views differing from those presented here are referred to the article of Dr. Emil Mayer in the *New York Medical Record*, 1898, vol. liii. p. 190. The instruments devised by Ash for the operation are, first, a strong cartilage scissors, one blade thick and blunt for introduction into the obstructed nostril, the other (the cutting blade) of a curved wedge shape, the shanks curved outward so as to admit of closing without interfering with the columna. The handles are steel, curved like dental forceps. The second instrument is a curved gouge for breaking up adhesions that may exist between the septum and the turbinal. The third is a forceps with stout parallel blades. This instrument is very powerful. The adhesions are broken up with the gouge. Then the blunt blade of the scissors is

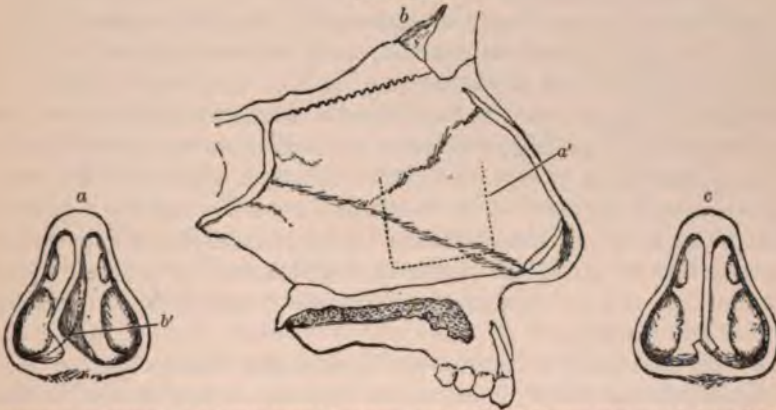
inserted into the obstructed nostril, the cutting blade into the other. A crucial incision is then made in the region of greatest convexity, with the cuts as near as possible at right angles to each other. The forefinger is then inserted into the obstructed nostril, the segments made by the incision are pushed into the opposite one, and the pressure continued until they are broken at their base and the resiliency of the septum is destroyed. Ash states that on this point depends the success of the operation, for unless the fracture of these segments be assured, the resiliency of the cartilage will not be overcome and the operation will fail. Fracture of a segment, however, that consists wholly of cartilage is not possible, and resiliency can only be destroyed if the flap have a bony base at which it can break. The septum is then to be straightened with the strong forceps and the hemorrhage checked before proceeding further. Tamponing may be required to stop the bleeding, though this may yield to a spray of iced Dobell's solution. Tubes of hard rubber, flattened and of various sizes, are next introduced, and should be large enough to fill the nasal fossa, the larger one on the side where the convexity was. The tube is removed from the naris having the septal concavity next day, the one from the side with the convexity after forty-eight hours. It should be cleaned, the nasal fossa irrigated, and the tube replaced and removed daily, a manipulation that the patient can learn to perform. The tube should be worn for from five to six weeks, to prevent recurrence of the deformity. The edges of the flaps made by the crucial incision will firmly unite, the epithelium being lost from their opposing surfaces. To facilitate the making of the vertical cut, Ash has added a second pair of scissors, with the blades applied at an angle to the flat of the shank. The strong forceps is never to be used to give the septum a twist, as fracture of the perpendicular plate of the ethmoid bone might result, with serious consequences. The forceps is merely to be used to bring the septum into a straight line by closing its blades. Perforations of the septum may occur. When the septum is irregularly thickened or of great strength this operation is wholly unsuitable.

Difficulty may be experienced in reducing the deformity by any operation mentioned if the septal deflection be continued back into the bony septum. To reduce this bony continuation of the deflection Roe has devised a forceps one blade of which is a ring which fits into the other blade. With this he breaks up the osseo-cartilaginous septum. Roe calls attention to the fact commonly observed that deflection of the anterior part of the bony septum is almost invariably present in deflections of the cartilaginous part. He reduces these by the Gleason, Ingals, crucial incision, or other method, or with a knife he incises the highest point of the deflection in the shape of a Greek cross, bevelling the edges. At the same time, if needed, he makes an additional incision along the lower border of the septum. These cuts are, if possible, made beneath the mucous membrane and with-

out piercing the other side. Instead of tubes he uses tampons for six days.

An operation having also a limited field of usefulness, but one more to be commended than the crucial incision, is Gleason's. Its advantages over the former are that local anæsthesia is employed, that the instruments used are light and not liable to do violence to the interior of the nose, and that with the patient in the sitting position they are under the intelligent guidance of the hand and eye. The Gleason operation is especially useful for vertical columnar deviations, though it can also be used for horizontal ones. Gleason describes two forms of deflection. In one the septum is thickened so that removing the projection on the convex side does not open the opposite nasal fossa, thus avoiding a perforation, and such deflections he simply saws away. The second

FIG. 149.



Gleason's operation. *a*, anterior view of septum, dotted line indicates saw cut; *b*, lateral view of septum, dotted line shows U-shaped flap; *c*, anterior view of septum, showing flap pushed through into other nostril.

kind of deflection includes the angular, curved, and sigmoid forms. The operation for these he describes as the button-hole or flap operation, and the instrument used is a Bosworth saw, which is introduced against the septum close to and parallel with the floor of the nose. With the saw he makes a transverse cut until the teeth have penetrated into the cartilage or bone; its direction is then changed until nearly vertical, carefully retaining it in a position parallel to the intermaxillary suture. The sawing is continued until a U-shaped incision has been made through the septum surrounding, except above, the whole deflected area. The dotted line (Fig. 149, *b, a'*) shows the position of the saw cut. The U-shaped cut is larger on the convex side of the septum. The dotted line (Fig. 149, *a, b'*) represents the smaller size of the U-shaped cut on the concave side of the septum. The result is a button-hole with bevelled edges through the septum, covered by a tongue-shaped flap. From the lower

end of the flap and from the portion of the septum upon the concave side below the U-shaped incision the mucous membrane is removed with the end of the saw or knife, and the flap pushed through the button-hole in the septum with the finger-tip, so that the parts assume the position shown in Fig. 149, *c*. The success of the operation largely depends upon the care that is exercised to thrust the flap far enough through the septum to enable its lower edge completely to clear the lower bevelled edge of the button-hole. When this is accomplished, the resiliency of the septum holds the denuded surfaces in contact, and there is little or no danger of the flap's returning through the button-hole with a return of the deviation; in fact, the flap tends to flatten out its thin bevelled edge in front, behind, and below. After the operation Gleason packs with gauze, metal, or cork tubes. When the deflection is of the horizontal type the flap is often not so well retained, and to prevent its slipping back it may be necessary to wear a tube for some weeks. When there is doubt whether the redundant tissue of the septum has the required strength to hold the flap in its new position, it is well to carry the U-shaped incision higher into the perpendicular plate of the ethmoid bone. The attachment of the flap to this can then be fractured and thus the resiliency destroyed. Cartilaginous parts of the flap cannot be broken.

When there is a pronounced deflection, with walls that are not too thick, Gleason's operation is an excellent one; but when the concavity is but slight by reason of a thickening of the septum filling it out, while the convexity may be great, the unyielding septal wall is not well designed to form a flap, and the opening on the concave side will be too small to force the flap through.

The fact that many deviations have two angles of deflection—a vertical and a horizontal one low down on the septum—is the basis of Watson's mode of operation. He makes an incision through the septum on its convex side from behind forward, just below the horizontal angle, beginning at the bony septum and extending as far as the deflection reaches. The direction of the cut is from below up towards the other side. This bevels the incision. The vertical angle is divided also to the other side, the cut likewise being a bevelled one. This makes the flaps slide over each other. If the angle of deflection be much thickened, it should be removed as a wedge. Watson then pushes over the whole of the upper part of the septum, which jumps over the lower fragment and hooks onto its other side, retaining itself in place. Deflections of the bony septum he breaks up with Adams's septal forceps, and the redundant thick lower portion on the convex side he removes at once or later with the saw. He uses a tenotome for the incision. He tampons with gauze, and if the fragments will not stay in place he passes a pin through them, beginning in the concave side, passing it through to the convex one across the vertical incision and back again to the concave side. The head of the pin he covers with rubber.

John B. Roberts makes a long incision at the most prominent portion of the deviation, and to overcome the resiliency of the septum makes numerous incisions with a stellate punch. Any horizontal bony edge that may remain at the bottom he cuts away with the chisel or saw. He then introduces a steel pin into the more open nostril, thrusts its point through the anterior portion of the septum, and, after forcing its curved part into the proper position, buries the point in the tissues of the posterior part of the septum on the formerly occluded side. For use in this manner the pin should have a smooth glass head to avoid irritation of the columnella. It may be left in place about one week. He often introduces a second pin from the external surface of the nose just below the nasal bones (Fig. 150).

Beaman Douglass modifies the operation of the crucial incision by one in which the cuts are made with the guidance of the finger, and in this respect his mode of operating is an improvement over mechanical methods. He examines the deflection for its ridges and highest points with the finger before operating. Then he introduces a knife, called the spear knife, whose short, sharp-pointed blade is attached to the shank at right angles. With this he pierces the septum at its greatest convexity. He then feels for the point of the knife with the finger in the other nostril, and makes an incision three-quarters of an inch long. Into this slit he passes a second probe-pointed knife, whose blade is attached to the shank in the same manner. With this he slits the ridged portions of the deflection, the blade following the summit of the ridges for their entire length. In this manner he divides the septal deviation into as many parts as there are ridges. These are then forced over in the manner already described.

All the operations described above have this in common, that the incisions cut through the entire thickness of the septum, and that they depend on overcoming the deflection by overlapping of the flaps created. This is practical where the septum is of even and normal thickness, but in the many cases where all of it is thicker than normal, or where large portions of it are transformed into buttresses of thick cartilage, it cannot be so neatly folded out of the way, and the redundant tissue, not being removed, obstructs the nares. In those methods which depend on crucial or similar incisions and forcing over and holding the flaps in place until united, the natural elasticity of the cartilage will assert itself, the more so the thicker the septum, so that there is liability to return of at least a part of the deformity. These objections pertain to the procedures that have been mentioned, and for this reason Ingals aims at the entire removal of all redundancy of the buckled septum. The Ingals operation is especially applicable to the common angular deflections having a

FIG. 150.



Roberts's operation.

vertical and a horizontal angle, described as the box-corner shape. As a preliminary to its performance the field is anæsthetized on both sides of the septum by being swabbed over several times with a solution of atropine, one-tenth grain; strophanthin, one-fifth grain; oleum caryophylli, three minims; carbolic acid, ten grains; cocaine muriate, twenty grains; water, enough to make one ounce. The parts are sprayed during the last applications of this solution two or three times with the adrenal

FIG. 151.



Ingals's submucous cartilage knife (one-half natural size). For destroying resiliency of cartilage without perforation.

solution mentioned under the treatment of intumescent rhinitis. The effect of the adrenal solution is markedly to limit the annoying hemorrhage. About twenty cotton swabs, on long four-cornered applicators tapering to a quadrangular point, are needed to wipe off the blood which interferes with vision during the operation.

An incision is made with Ingals's septum knife or Sajous's knife (Fig. 152) along the vertical angle from above downward to the horizontal, and

FIG. 152.



Sajous's knife (one-half natural size).

along this as far as it extends forward. This outlines a flap of mucous membrane, which is peeled from the cartilage upward and forward with a spud. With Ingals's cartilage knife the bared cartilage is outlined as far as the deflection extends forward in the form of an A or triangle with the apex upward, its base following the horizontal angle and its forward limb keeping close to the base of the mucous flap, which is to be kept raised out of the way. The triangular piece of cartilage thus severed at

FIG. 153.



Ingals's septum knife (two-fifths natural size).

its borders is next separated from the mucous surface of the other naris with a small, flat spud with sharp edges. This manœuvre must be carried out with great delicacy, as it is easy to perforate the mucous membrane into the opposite nostril. A simple slit in this is of no great moment, but perforations far forward in the nose within the first inch of the septum, unless very small, are apt to be the seat of annoying

crusts. Back of this perforations (to be avoided if possible) generally do no harm, but may give rise to a whistling sound. This is, however, a very rare occurrence, as openings through the cartilaginous septum are frequently met with, and patients seldom complain of this symptom. The moisture of the air back of the first inch of the septum prevents the edges of perforations from crusting, as the secretions do not dry.

FIG. 154.



Ingals's spud (one-half natural size). For lifting flap in operating on septum.

When the triangle of cartilage is removed the redundant portion of the septum in front of the vertical angle is disposed of, and there remains yet the portion between the horizontal angle and the base of the septum to remove. This can be taken away by means of a saw, making two vertical cuts from below up, one close to the base of the septum and the other following a line at a distance within the crest of the hori-

FIG. 155.



Ingals's nasal saw (one-half natural size).

zontal portion of the deflection equal to the thickness of the septum. These cuts are to penetrate into the other nostril. The same result can, however, be attained much more easily and quickly with a large trephine driven by a dental engine, the trephine removing the tissue between the base of the septum and the horizontal crest of the deflection. The base of the deflection having been thus removed, it is necessary to destroy the

FIG. 156.



Sharp and Smith's adjustable nasal saw (one-half natural size). The blades cut forward or backward, and may be adjusted to any desired angle to the handle.

resiliency of its upper part so that it can be brought over to a central position. To accomplish this a small trephine, one-eighth of an inch in diameter, may be used to take out one or two cores from the septum from before backward, or the resiliency may be destroyed by the nasal septum cutting forceps (Fig. 157). The cutting may need to be done on both sides of the septum, and the set-screw should be used to avoid piercing

the mucous membrane on the side of the septum opposite the cutting blades. These procedures destroy the resiliency of the upper attachment of the deviation and permit it to be forced over to the median line. This can be done with the finger or septum forceps. The flap should stay in place without pressure, as it is absolutely necessary that all resiliency should be destroyed, otherwise the deformity will reproduce itself in the course of time. As the upper fragment of the deviation swings over to meet the base of the septum it closes the perforation made by the saw or trephine.

In that type of deflection presenting a curved and not an angular sur-

FIG. 157.



Ingals's septum forceps. By removing the screw the cutting blades may be removed. The cutting blades are used to destroy the resiliency of the septum in operations for deflection.

face a trephine suited to the thickness of the septum is introduced into the commencement of the bend at its anterior part without a preliminary incision of the mucous membrane, and by means of the leverage offered by the hand-piece of the dental engine the trephine is made to follow the curve of the deflection within its substance until it reaches its posterior part, when it re-enters the naris. The trephine follows a horizontal direction. In this way core after core is removed from the substance of the septum, with intervals of about one-eighth of an inch, until it has been reduced in material and is sufficiently limp to easily be pushed

FIG. 158.



Ingals's heavy bone-scissors (one-third natural size).

over to the median line. If the resiliency of the septum be not enough reduced by the removal of the cores, the bridge between the openings can be cut with the cartilage knife. This is entered through a small opening in the mucous membrane, and forced back between the mucosa and the cartilage; it is then turned, with the cutting point towards the cartilage, more or less obliquely as desired, and drawn forward and downward. It does not cut through the mucous membrane on the opposite side.

Preservation of the mucous membrane of the septum as much as possible is of great importance in operations on this structure, and no more should be sacrificed than is absolutely necessary. Rapidity of healing is greatly promoted by its remaining intact.

The after-treatment is simple. Nasal spatulæ are introduced on each side of the operated naris as far back as they will go, and a long strip of lint thoroughly impregnated with boric acid and iodoform or iodol powder is packed in between them. They are then withdrawn, leaving the tampon in the naris. The packing is to guard against secondary bleeding rather than to keep the deviation in place, as this should stay over of its own accord if the resiliency be destroyed. The lint strip also applies the mucous flap to the denuded surface whence the triangle of cartilage was removed. The dressing can be taken out on the fourth day and, if there be hemorrhage, replaced; if not, the naris need merely be closed with a pledget of cotton to keep out the dust. Irrigations are not needed. To prevent crusting, antiseptic oily sprays may be used, or vaseline oil from an oil-can may be dropped into the nose by the

FIG. 159.



Ingals's nasal spatula (one-half natural size). Sets of three varying in width; angle of forty-five degrees. Made of steel.

patient. Crusts are liable to form for six weeks after the operation. If far forward, an ointment of vaseline and lanolin, each one-half ounce, with ten grains of salicylic acid, can be applied with a camel's-hair brush or soft swab by the patient. Ointments stay in place much longer than oils, and are therefore more effective.

In no class of operations is more original thought needed than in those for septal deflections. It may be necessary to combine the ideas of different methods to suit the case. Those operations done under the guidance of the eye with local anaesthesia involve a minimum of traumatism and pain to the patient, and are to be preferred whenever feasible.

When *deformity of the nose and obstruction to respiration* result from protrusion of the anterior edge of the triangular cartilage to one side, the most satisfactory operation consists in incising the mucous membrane over the edge of the cartilage, dissecting it back upon both surfaces, and then cutting off with scissors all of the cartilage that projects beyond the normal plane of the septum into the obstructed nostril. This operation not only relieves obstructed respiration but largely remedies the external deformity or twisting of the nose.

ECCHONDROSIS AND EXOSTOSIS OF THE NASAL SEPTUM.

Ecchondroses and exostoses of the nasal septum occur commonly in the form of sharp spines or spurs and as longer ridges or crests. Though these may occupy any portion of the nasal septum, there are certain places of predilection due to the mode of development of the septum. The chief of these is the junction of the vomer with the quadrangular cartilage and perpendicular plate of the ethmoid bone. The vomer is deeply grooved along its anterior border for the reception of these structures. In early life a tongue of cartilage exists between the groove of the vomer and the perpendicular plate of the ethmoid; this may extend back as far as the alæ of the vomer or end short of it. This cartilaginous strip is continuous with the triangular cartilage, and may remain unossified till late in life. It may be surrounded by bone, in which case it retains its normal dimensions, or one or both of its borders may be uncovered by it if one or both of the lips of the vomer's groove remain rudimentary. In this case the cartilaginous strip, which is called the cartilago vomeris, is relieved from retaining pressure, and grows out into one or both nares in the form of a spur or crest, according to the extent to which one or both lips of the vomeral groove are defective. The crest never extends along the whole length of the vomer on both sides, but may do so on one while it reaches part of the way back on the other. The proper understanding of this matter is due to the work of Zuckerkandl.

Anteriorly, as far as the quadrangular cartilage extends, crests or spurs are generally cartilaginous, though even here they may contain bone. Back of this they may contain cartilage in a shell of bone, the remains of the cartilago vomeris, or the exostosis may be solid bone of ivory-like hardness, and is almost always troublesome to saw away. The perpendicular plate of the ethmoid bone takes but little part in the formation of crests or spurs, but may be deflected if it slip from the vomeral groove. Another site in which cartilaginous outgrowths are apt to appear is at the anterior part of the septum where this joins the nasal floor, just behind the nasal vestibule. Two small cartilages, called the vomeronasal cartilages of Huschke, are situated here between the vomer and superior maxillary crest, beside the nasopalatine canal. They may grow out into cartilaginous protuberances at the foot of the septum of large enough size to produce appreciable obstruction.

Symptoms.—The symptoms are those of deflections just described. These formations, because larger and exerting more pressure against the outer wall, are more liable to excite neuralgic pain and various other nervous symptoms than are simple deviations of the septum. They are frequently found in cases of hypertrophic rhinitis, hay fever, asthma, and persistent supra-orbital or occipital neuralgia, but may not have any influence on the latter affections. If, as is often the case, the ecchon-

drosis or exostosis is combined with a deflection, simple inspection may not enable one to diagnose its existence or, at least, its extent, and the aid of the septometer will be needed. Simple spurs or crests may occasionally be seen protruding on both sides of the septum, but usually one side of this is found normal. The concavity of the septum in the unobstructed naris, found with deflections, will be missing. It may be impossible to tell how far back a ridge extends until it is removed, but a probe can usually be hooked around a spur.

Diagnosis.—As a rule, the diagnosis presents no difficulties. The points distinguishing ecchondrosis and exostosis from deflections have just been mentioned. Soft tumors can be differentiated with the probe, which shows the characteristic hardness of bone or cartilage. Osteomata and chondromata in their early stages may be difficult to differentiate if they originate on the septum. They have a rounded or oval form, while septal spurs are pointed and crests present a sharp edge. Later the inflammation of the mucosa, fetid discharge, and increasing and severe pain caused by osteoma, with the displacement of neighboring structures, make an error in diagnosis impossible. Similar symptoms help to distinguish chondroma, which, however, is generally covered with sound mucosa. Chondroma is extremely rare.

Prognosis.—The obstruction may be completely removed by suitable operation, and many of the symptoms will be relieved accordingly; but the surgeon should not be too confident of the result, for in a considerable number of cases some of the symptoms will remain. It is also well to be guarded in the prognosis as to recurrence of the deformity after operation. Though in most cases the wound left after it will heal over smoothly, in some persons, especially vigorous young subjects with great tissue-forming power, an exuberant callus will replace the spur or crest wholly or in part, and make a cauterization of the callus or its second removal necessary.

Treatment.—The excessive tissue must be removed by operation, during which an effort should be made to save as much of the mucous membrane as possible. Before commencing the operation, the septum, both upon the affected and upon the opposite side, and all other portions of the walls of the cavity liable to be touched should be thoroughly anæsthetized by cocaine in combination with the adrenal solution, as recommended in the treatment of deflections of the septum. It will be found impossible to produce complete anæsthesia by applying cocaine to the surface near the nostrils; therefore, when the incision is to extend far forward, a drop or two of the solution should be injected beneath the mucous membrane where it joins the integument. Ecchondrosis near the nostril may be removed by dissecting up the mucous membrane and paring away the cartilage with a knife, or by cutting it with saws, trephines, or drills. Drills or trephines can be used with the electric motor. De Vilbiss has devised a surgical engine, driven by hand, which

growths after their reduction with caustics, scissors, or saw. Electrolysis is also the best method for the removal of exostoses or ecchondroses in people who refuse cutting operations, and who would go unrelieved if there were no other way of helping them. Some object to the losing of a day or two from business that a bloody operation necessitates, but between the sittings of the electrolytic process they can go about as if nothing had been done, and no pain or discomfort is felt. It is also a method well suited for children, the soft young cartilage and bone of whose septa yield readily to the process, while their own and their parents' horror of the knife may be insurmountable. When deflection complicates ecchondrosis electrolysis is not suitable, but when the latter exists without this complication even large outgrowths can be removed by patient effort with this method. The apparatus is described under hypertrophic rhinitis. The bipolar method, in which both the positive and negative needles are thrust into the outgrowth, is the most rapid and effective. The needles can be used singly or bound together in the manner of a cautery electrode, and the current strength should usually not exceed twenty milliamperes. The strength of current used will depend greatly on the patient's tolerance, and effective work can be done with even ten milliamperes. It is well not to extend a single sitting beyond six minutes, so that the amount of tissue destruction can be watched and perforations avoided. Spurs or crests which have returned after operation can usually be destroyed in one or two sittings, and cartilaginous outgrowths may be softened in two or more. Moritz Schmidt says that even bony prominences may be removed in from five to eight or even more treatments. As the outgrowth softens in advance of the needles, these are to be pushed into the cartilage or bone. There is little inflammatory reaction and no after-treatment is needed. The sittings should be at least a week apart, to give time for sloughs to separate and softened tissues to be absorbed. The current is to be introduced very gradually by means of the rheostat, and the amount of pain can thus be almost mathematically controlled. The pain is often referred to the upper incisor teeth on account of irritation of the nasopalatine nerve. It should be remembered that this method may lead to perforations, and therefore it had better be avoided far forward on the septum, within its first inch, or at least used here with great caution. For other particulars relating to electrolysis the reader is referred to foregoing parts of this work.

PERFORATION OF THE NASAL SEPTUM.

The commonest form of this lesion is that called idiopathic perforation of the septum, or *ulcus perforans septi*. It occurs exclusively on the cartilaginous part, and its existence is usually unknown to its possessor, chance or the physician discovering it.

Etiology.—Among the causes of perforation of the septum are syphilis, tuberculosis, lupus, malignant growths, abscess, hæmatoma of the septum, and operations. A variety of perforation of the septum called idiopathic or simple is very common, and in some few instances is congenital, being due to incomplete development of the septum. Many idiopathic perforations are caused by picking the nose, and are due to the extension of the little erosions and ulcers created thereby. They are often found in cement-workers or those whose occupations bring them in contact with potassium bichromate. These materials gather in the nostrils, irritate the mucous membrane, and lead to picking the nose. Other cases, Zuckerkandl thinks, are the result of low vitality and local interference with the nutrition of the cartilage. These may lead to its atrophy, or to its death and perforation if local infection occur. Such conditions exist in typhoid fever, phthisis, and other exhausting diseases, and perforation of the septum occurs with some frequency in atrophic rhinitis.

Pathology.—In idiopathic perforation the first lesion is always an ulcer on the mucous surface on one or both sides of the septum, and the edges of the mucosa can be lifted up from the surface of the cartilage when this becomes exposed. As the disease advances the cartilage presents a defect with sharp edges, and finally perforation of the mucous membrane in the other nostril takes place. The pathological appearances of the other forms of perforation have been considered under the diseases causing them.

Symptoms.—Pain is not a pronounced symptom in simple perforating ulcer of the septum, nor is it prominent in the other varieties. The progress of the disease generally causes so little annoyance that the patient is made aware of it only by the crusts which occlude the nostril and lead to repeated injury with the finger-nail. Nose-bleed is a common symptom.

The most important result of perforations of the septum is deformity. This is very rare when only the cartilaginous septum is perforated, as in the idiopathic form, even if this be so large as to leave a mere frame of cartilage around the opening in the septum. On the other hand, if the vomer or perpendicular plate of the ethmoid bone be destroyed, the nose is almost sure to recede below the nasal bones, creating an unseemly angle with them. This is not invariable, however, as loss of almost the entire bony and cartilaginous septum may occur with no appreciable deformity of the external nose, much depending on cicatricial processes which pull the latter backward. After perforations of the septum have healed they present smooth, sharp borders, generally of healthy appearance. This is especially true of the idiopathic variety. When they are situated far forward on the septum they are liable to collect crusts on their circumference.

Diagnosis.—For the diagnosis of the various forms of perforation due to the diseases mentioned the reader is referred to their respective

articles. Idiopathic perforation of the septum is always limited to the cartilaginous portion, while syphilitic perforations almost always involve the bony portions as well, though they may destroy the cartilage at the same time. Syphilitic perforation limited to the septal cartilage, though extremely rare, may occur as the result of perichondritis.

Treatment.—The treatment consists in making suitable applications to heal any ulceration that may be present. It is not worth while to try to close the opening; an attempt, even at best, will afford little benefit, and usually results in failure.

When the cartilaginous rim of the perforation extends beyond the mucous lining and is covered merely by cicatricial tissue, it is the seat of a permanent raw surface with soreness and crusting. This can be relieved by paring the mucous membrane from the projecting cartilage and removing this with nasal bone-forceps, knife, or scissors, thus forming flaps of mucous membrane which, when united, will cover the cartilage and do away with the soreness and crusting.

HÆMATOMA OF THE NASAL SEPTUM.

Hæmatoma is a collection of blood beneath the mucoperichondrial covering of the septum, characterized by the formation of hemispherical tumors on both sides of the septum at its anterior lower part.

Etiology.—Hæmatoma may, in rare cases, be of spontaneous formation, but is almost always the result of violence to the external nose, producing excessive bending or infraction of the cartilaginous septum.

Pathology.—In hæmatoma the effusion of blood usually takes place between the quadrangular cartilage and the perichondrium, and does not involve the bony septum. The entire septum, cartilaginous as well as bony, is composed of two plates, one for each side, united by diploetic substance. Paul Heymann has found that in many instances the blood collects between the plates of the quadrangular cartilage. In the usual form of hæmatoma the blood lifts the perichondrium from the cartilage on both sides of the septum and forms two hemispherical tumors, generally symmetrical in location, while the mucous surface over these may be unchanged in appearance, or ecchymotic with a purple color. The swellings may be seated higher up on the cartilaginous septum or near the nasal floor, and their size varies from effusions merely producing thickening of the septum to globular tumors that fill the nasal vestibule and give a broad appearance to the external nose by distending the nostrils.

Unlike hæmatoma elsewhere, in the septal variety the effused blood shows no tendency to absorption. In the course of days or weeks the contents of the cavity change from blood to bloody serum or pus, while the tumor gradually grows. The traumatism causing the hæmatoma may fracture the cartilage, or this may become necrosed as the result of the

abscess formation, so that in a few cases perforation results. In most instances after opening the hæmatoma the perichondrium reapplies itself to the cartilage that remains intact.

Symptoms.—At the time of the accident there is usually some nose-bleed, which may be but slight. The pain felt after the injury generally soon subsides, and the hæmatoma itself causes but little, if any. For this reason patients generally delay seeking advice until some days or weeks after the accident, being finally led to do so by the discomfort of the gradually increasing nasal obstruction caused by the slow growth of the hæmatoma.

Diagnosis.—The chief points in the diagnosis of hæmatoma are traumatism, the bilateral appearance of the tumor, the usually normal and smooth mucosa over it, its hemispherical form, and feeling of fluctuation. These qualities differentiate it from ecchondrosis or exostosis. Nasal mucous polypi permit the probe to pass between them and the septum; their appearance is translucent and gelatinous, while the mucous membrane over a hæmatoma is normal or purplish in appearance. Tumors of the septum are unilateral and of slow growth as compared with hæmatoma. They do not fluctuate, and are generally firm. As abscesses of the septum are mostly due to hæmatoma, the difference between simple hæmatoma and abscess can be discovered only by exploratory puncture and aspiration and consideration of the etiology. Gumma of the septum is not the result of an accident to the nose, and is of slower growth than hæmatoma. It is soon followed by crusts, ulceration, perichondritis, or perichondritis with necrosis.

Prognosis.—Even those hæmatomata ending in abscess usually recover, the perichondrium reappling itself to the cartilage. Perforations rarely result. The course of the disease generally extends over weeks and months, as the patient seeks help late and the perichondrium is slow in reuniting with the cartilage, so that treatment is needed for some time.

Treatment.—The proper treatment is by incision, and the cut should be extensive, as the opening shows a great tendency to close again. In some cases it may be necessary to follow the plan of Schäffer, and excise an elliptical piece of mucosa and perichondrium with scissors. After opening the cavity, it should be packed with iodoform gauze or some substitute until healing occur. If there be an opening in the septum, incision on one side may suffice for drainage; if the septum be intact, it is necessary to incise both sides.

ABSCESS OF THE NASAL SEPTUM.

Abscess of the septum may take an acute or a chronic course. Acute abscess is usually the result of hæmatoma, erysipelas, typhoid fever, or small-pox; chronic abscess is generally due to syphilitic infection, but arsenic, copper, and mercurial poisoning have been assigned as causes. Perichondritis is the basis of all abscesses of the septum not traumatic.

The mucous membrane of the septum has no submucous tissue, but is directly attached to the cartilage or bone, its deepest layer taking the place of the periosteum or perichondrium; therefore any lesion penetrating the mucous surface is likely to lead to perichondritis or periostitis, with shutting off of the supply of nutrition to the cartilage and bone and their consequent necrosis. As these lesions affect, as a rule, the anterior part of the septum, simple abscess of the latter is practically confined to the cartilaginous portion, and presents the appearance described as pertaining to hæmatoma. Syphilitic abscess, however, is more destructive, and in nearly all cases extends back to the bony septum. Syphilitic abscess of the septum results from a gummatous infiltration of the mucous tissues. When seen before they have opened, syphilitic abscesses present very much the same appearance as the simple form. The same swellings of rounded shape are seen filling the nasal vestibule and hiding the parts back of this from view, the mucous membrane over these is apt to appear red and inflamed, more so than in simple abscess, and the swelling is quite painful to the touch. When syphilitic abscesses are opened, however, the difference between their destructiveness and the slight, if any, damage done by simple abscess becomes apparent. In syphilitic periosteal abscess the probe finds cartilage and bone necrotic, and the characteristically foul odor from the decay of these structures soon sets in. It is, therefore, well to consider that an apparently simple abscess may, upon being opened, prove of the destructive syphilitic variety. The treatment of simple abscess is that of hæmatoma. Those of syphilitic origin are to be treated as suggested in the article on nasal syphilis.

CHAPTER XV.

ACUTE AND CHRONIC RHINOPHARYNGITIS.

ACUTE RHINOPHARYNGITIS.

Synonymes.—Acute postnasal catarrh, acute retronasal catarrh.

ACUTE CATARRH OF THE NASOPHARYNX is a frequent and important disease. It would be of less consequence were it not for the aural complications that often accompany it.

Etiology.—No disease better exemplifies the evil results of undue exposure to cold, especially by those unused to it, than rhinopharyngitis. In some individuals it follows a wetting or prolonged chilling so promptly that its victims can almost count on its appearance. It is probable that exposure to cold merely diminishes the local resistance to infectious germs which find the nasopharynx, so rich in lymphoid tissue, a favorable place for invasion. This is further emphasized by the fact that the course of most cases of acute rhinopharyngitis is that of an acute infectious disease, with fever and purulent secretion, and by the occurrence of rhinopharyngitis with certain general infectious ailments, especially scarlet fever, in which disease it creates marked symptoms. Some suppose that the lymphoid tissue of the nasopharynx is the gateway through which the germs of many of the general infections enter the organism. The infectious nature of many cases of idiopathic rhinopharyngitis in children is shown by the simultaneous enlargement of the submaxillary lymph-glands. Acute rhinopharyngitis often follows acute rhinitis, but may precede it.

In the fibrinous forms of acute postnasal catarrh the microbes which have been found are the staphylococcus pyogenes aureus, the streptococcus pyogenes, and the diplococcus pneumoniae.

Acute rhinopharyngitis is often the first manifestation of influenza, the bacillus of this disease having effected its lodgement in the lymphoid tissue of the nasopharynx.

Pathology.—The pathological changes presented by the acutely inflamed nasopharynx are often associated with an acute inflammation of the oropharynx in adults, but seldom so accompanied in children, in whom the disease is apt to confine itself to the postnasal space. The character of the inflammation is greatly affected by the presence to a greater or less degree of the normal lymphoid elements of the nasopharynx. When these exist in a large mass, as they generally do in childhood, they form what is called Luschka's tonsil, a structure which has usually atrophied by the time adult life is reached. In acute rhinopharyngitis in children

general sensation of a sore throat. The swelling of the pharyngeal mucosa is hardly enough to alter the timbre of the voice, unless the posterior ends of the turbinals become œdematous as the result of a complicating rhinitis. Almost as great distress as that caused by the sore throat results from the tough secretion, which has to be removed by drawing back through the nose and scraping the throat. When, after a few days, the discharge becomes viscid and dries into tough masses, and even crusts, its removal becomes very difficult, and may be attended by slight bleeding that alarms the patient. The inflammation rarely remains confined to the nasopharynx, but generally terminates in an acute rhinitis or passes down the oropharynx to the larynx and trachea. In a few cases, even not severe ones, the lymphatic glands of the region back of the jaw and some of those of the neck may enlarge and become tender. Aural complications are quite as common as in children, but usually take the form of acute catarrhal otitis media, with no pain, but more or less deafness, which is usually transient. In the higher grades of acute rhinopharyngitis in adults there may be a great deal of purulent secretion produced in the nasopharynx, and even abscesses form at times in this region. Suppurative otitis media, with often large perforations, may occur, and mastoiditis and other serious complications result. The fever runs a prolonged course and the illness is severe. An average case of acute catarrh of the nasopharynx in adults lasts a week or ten days. The fibrinous form tends at times to become subacute and extend over weeks.

Diagnosis.—The acute onset of mouth-breathing, fever, and swollen submaxillary glands and the absence of intranasal obstruction sufficiently distinguish the ailment from adenoid vegetations. In many children affected with these, however, the vegetations become the seat of repeated inflammation, so that attacks of complete or almost complete arrest of nasal respiration, with fever, are followed by periods during which the child may breathe fairly well through the nose.

In adults posterior rhinoscopy usually makes the diagnosis easy. Only cultures obtained from secretion swabbed from the nasopharynx in fibrinous postnasal catarrh can distinguish the disease from diphtheria of this region. The culture should, however, not be waited for, but antitoxin injected immediately and the case treated as a diphtheritic one.

Prognosis.—This is generally favorable as to the rhinopharyngitis, but the result of the aural complications cannot be foreseen.

Treatment.—In little children local treatment is impossible, and, if it were not, would be, as in most acute microbial invasions, of little benefit to the affected tissues. The fever can be modified by antifebrin or other antipyretics, and in some mild cases antifebrin or the salicylates seem at times to shorten the course of the disease. Local applications to the neck only annoy the child. When the secretions seem to collect in the nasopharynx, their removal can be aided by dropping into

the child's nose about ten drops of a mild alkaline solution; for instance, a half-drachm of sodium bicarbonate to a tumblerful of water. In the adult rhinopharyngitis is often favorably influenced by salol or sodium salicylate. Antifebrin is useful in feverish cases, and quinine in large doses once or twice daily tends to cut short the disease.

Locally, in the first days of the ailment, a spray of cocaine, one grain to the ounce of a saturated boric acid solution in water, may be used by the patient, and will give relief to the dysphagia. If sprayed directly back along the nasal floor it reaches the nasopharynx, especially if the patient be in the recumbent position. Later, when the secretions begin to collect and annoy the patient, they may be washed away with Freer's nasal irrigating tube, a solution of potassium permanganate strong enough to have a light pink color being used. When the secretions have a tendency to dry and crust in the nasopharynx, oily sprays of oleum petrolatum album will dissolve the masses. This spray should be used by the patient himself, or he may employ, if skilful enough, a fine brush on a long, thin handle, to convey vaseline jelly into the posterior part of his nose, whence the oily matter will spread over the postnasal space. The oil-can with vaseline oil, mentioned in other parts of this work, may be employed.

CHRONIC RHINOPHARYNGITIS.

Synonymes.—Postnasal catarrh, retronasal catarrh, follicular disease of the nasopharynx.

Chronic rhinopharyngitis is a chronic catarrh of the nasopharynx often associated with the same condition in the oropharynx and larynx, but usually, at least in America, not descending below the postnasal space. Chronic rhinitis in some of its forms very frequently accompanies the disease. Postnasal catarrh is so much more frequent in America than elsewhere that Mackenzie called it American catarrh. It is the ailment spoken of by the laity as "catarrh," and is much advertised by quacks to terrorize the ignorant.

Etiology.—Chronic catarrh of the nasopharynx is commonest between the ages of twenty and fifty, and is therefore properly a disease of adult life. The chronic catarrhal symptoms occasionally associated with adenoid vegetations in children yield on the removal of these growths, and are merely symptomatic. Among the remoter causes of chronic rhinopharyngitis are living in badly ventilated, dusty rooms, breathing an atmosphere full of tobacco-smoke, and abuse of the voice. Alcoholic excesses are very prone to cause the form associated with catarrh of the oropharynx which leads to hawking, retching, and vomiting in the morning.

In climates subject to sudden and extreme changes of temperature the disease is very frequent. Diminution of the proper supply of moisture to

the air, such as occurs in overheated houses, tends to perpetuate acute attacks of rhinopharyngitis, as the secretion dries on the mucous surface of the nasopharynx and keeps up a chronic irritation. Freudenthal, of New York, asserts that the normal atmosphere contains, as a minimum, from forty to fifty per cent. of moisture, and that in summer it often has from eighty-five to ninety per cent. of its maximum saturation. On the other hand, in theatres, dwellings, and other localities heated by artificial means he found from forty down to ten per cent., an amount of moisture less than that in the driest climates. Even in New Mexico the percentage of watery vapor is from fifty to sixty. To overheated houses, therefore, with very dry air he attributes the frequency of postnasal catarrh in America. The gouty diathesis, rheumatism, and chronic gastritis are to be considered as predisposing causes. Among the exciting causes frequent acute nasopharyngeal catarrhs are not etiological factors to so great an extent as one would naturally suppose; in fact, most of these recover completely. Excessive size of the nares is liable to cause chronic rhinopharyngitis by not permitting the air breathed to come intimately enough in contact with the surface of the nasal mucosa to gain sufficient moisture. Dust, also, is not arrested in the nares, but is carried directly back into the nasopharynx, and this is one of the reasons why the disease is so often associated with atrophic rhinitis. Extension of chronic rhinitis backward or of chronic catarrh of the pharynx upward may lead to the disease, as also may nasal obstructions from whatever cause, such as polypi, hypertrophic rhinitis, septal deflections, etc. In these cases mouth-breathing creates oral and pharyngeal irritations by contact with an air-current not freed from dust and warmed as it would be by passage through the nose. These lead to ascending catarrh of the oropharynx and involvement of the nasopharynx by continuity. Though many patients with nasal obstructions complain of frequent hawking of mucus from the nasopharynx, nevertheless, in a large proportion of cases the nasopharynx remains perfectly healthy. Those whose employments expose them to the inhalation of irritating dust are peculiarly liable to the disease, and this is also true of patients with valvular disease of the heart or lung diseases obstructing the venous circulation. Many cases are apparently caused by submucous thickening at the sides of the posterior part of the vomer. The direct relation of this thickening to the discharge and chronic inflammation cannot be explained, but its etiological relation is clear, as the reduction of the thickening will often greatly benefit, if not completely cure, the postnasal catarrh.

Pathology.—In many cases pronounced symptoms exist for years without the mucosa presenting anything appreciably abnormal on the most careful inspection, so that one is inclined to regard these cases as anomalies of mucous secretion rather than chronic inflammation. Other cases show more marked pathological changes, and are apt to be associated with hypertrophic or granular pharyngitis of the oropharynx,

intumescent rhinitis, or often with atrophic rhinitis. Chronic rhinopharyngitis accompanying the latter affection is apt to end in atrophy of the mucous membrane of the nasopharynx. The surface of the mucosa in these cases of chronic rhinopharyngitis is usually reddened and vascular, but may in some cases be even paler than normal. The mucous membrane is thickened and boggy in appearance. Microscopically, the epithelium shows an extension upward of the pavement epithelium of the oropharynx to a greater or less degree; in other places the epithelial surface is lost, or the ciliated cells are replaced by layers of cuboid ones. In children the ciliated epithelium normally extends downward on the

FIG. 161.



Adenoid tissue at vault of pharynx. Posterior wall of upper part of pharynx. (Luschka.) 1, 1, pterygoid process; 2, section of vomer; 3, 3, posterior portion of the vault of the nasal fossae; 4, 4, pharyngeal orifice of the Eustachian tube; 5, orifice of the bursa pharyngea; 6, 6, recessus pharyngeus (fossa of Rosenmüller); 7, median folds formed by the adenoid substance of the nasal portion of the pharynx.

FIG. 162.



Pharyngeal bursa. Antero-posterior section. (Luschka.) 1, section of basilar process of the occipital bone; 2, body of sphenoid; 3, pituitary gland; 4, adenoid substance of the vault of the pharynx, behind which is seen (5) the pharyngeal bursa.

posterior wall of the nasopharynx as far as the velum, while in adults it reaches only about one-third of the way down this surface. The connective tissue is increased in quantity and the lymphoid follicles are often found in a state of cheesy degeneration, or may have broken down into little ulcers. The outlets of the mucous glands are dilated, filled with round cells, and their epithelial lining may be in a state of fatty degeneration.

In this connection the so-called bursa pharyngea is to be considered. Luschka describes the bursa pharyngea as a sac-like recess in the pharyngeal vault, at the most one and one-half centimetres long and six millimetres wide. It ascends, penetrating the periosteum of the body

of the occipital bone. The sac lies against the posterior wall of the pharynx. It is situated near the lower and posterior part of the pharyngeal tonsil in the median line, and its opening is of the size of a pin's head. This is the pharyngeal bursa of Luschka. It is present in a small number of individuals, and is a natural formation dating from birth. Other authors mean by the pharyngeal bursa not only this *cul-de-sac* of Luschka, but any similar recess in the centre of the pharyngeal vault, even if of pathological formation. Bursæ of this type generally result from an unusually deep recessus pharyngeus medius, or central fissure of the pharyngeal tonsil. The bottom of this fissure remains attached to the periosteum of the roof of the pharynx, while its borders agglutinate and form a covered recess resembling the normal bursa. If this variety be added to the true bursa of Luschka, such tissue in the pharyngeal vault may be considered reasonably frequent. In whatever way a mucous pocket or *cul-de-sac* is formed, it can readily be understood that it presents a favorable seat for chronic, ill-drained suppuration, and that closure of its outlet may result in its distention from retained secretion. Disease of its inner lining is apt to lead to the formation of cysts, due to retention of the contents of occluded mucous glands. These cysts may be as large as a pea. The pharyngeal bursa may be the only part of the nasopharynx in a state of chronic inflammation.

In the atrophic form of chronic rhinopharyngitis the mucous surface of the entire nasopharynx may become pale, smooth, and atrophied. The adenoid or lymphoid tissue which forms so large a part of the normal mucosa of the nasopharynx almost disappears. The connective tissue is increased in quantity and the mucous glands are much diminished in number. The atrophic form of chronic catarrh of the nasopharynx is most often found in elderly people.

Symptoms.—The disease seldom causes pain in the throat or actual dysphagia, but rather a feeling of dryness and a raw sensation in the nasopharynx, intensified by swallowing. This may be associated with a tickling cough when the secretions flow down into the larynx. The patient complains of a sensation of secretions dropping from the nasopharynx into the oropharynx, and of a constant desire to hawk and clear the throat, even after the irritating secretion has been entirely removed, as the nerve-fibres of the diseased mucosa are hyperæsthetic. Some patients mention the sensation as of a foreign body in the throat. Though there be no pain in the throat, other nervous symptoms may be annoying, such as dull frontal or occipital headache, pain in the nape of the neck, and a heavy, tired feeling in the head. As chronic rhinitis is, however, so often associated with the disease, it is hard to tell whether or not these pains depend wholly on the rhinopharyngitis. The voice frequently suffers, either because of accompanying laryngitis or because masses of secretion block the posterior nares, at times suddenly getting in the way of the air-current, or else the chronic inflammation relaxes

the mucosa and the tone of the muscular coat of the pharynx, so that its walls lose their smoothness and proper tension during phonation. The discharge may be simply muco-pus or quite purulent, and in very many cases the secretion is altered in quality, showing a tendency to inspissation, so that the hawking of tough leathery or dry crusts, at times with blood, is a feature of the disease. This may continue all day, but in most cases the patient scrapes the accumulated secretions away in the morning and clears his throat much less at other times. Retching, strangling, and vomiting often accompany the morning toilet of the nasopharynx.

In some cases, but by no means a majority, there is associated with the chronic rhinopharyngitis chronic middle-ear catarrh, with deafness and tinnitus aurium. When this occurs with chronic catarrh of the nasopharynx it is almost invariably attributed to it, but seems, at least in many cases, to be a mere coincidence. Chronic otitis media is more frequently found in connection with a normal nasopharynx than with postnasal catarrh, and, though it may result from the latter, it so often constitutes an independent affection that it is not wise to tell a patient that relief of his catarrh will improve his hearing. Inspection may show the glue-like secretion flowing down the posterior wall of the oropharynx and coating it with a varnish-like surface. When this is removed the oropharynx may be found normal, or more rarely it may present the appearance of granular or chronic hypertrophic inflammation. Posterior rhinoscopy commonly shows a mass of dried or semi-fluid purulent secretion in the centre of the pharyngeal vault, which may be limited to the region of a true or pathologically formed bursa or the central fissure of Luschka's tonsil, while the rest of the nasopharynx is healthy. In other cases the vault of the pharynx, the choanæ, and, more rarely, the region of the Eustachian orifices may be hidden by discharge. After the latter has been washed away the nasopharynx may present a normal appearance or the changes in color and the swelling mentioned in the pathology. Often the patient's efforts during the day have dislodged the secretion, so that the most careful inspection presents nothing abnormal, and his complaints seem without reason. If, however, a case of this kind be examined in the morning, before the discharge has been scraped away, it can be seen in the nasopharynx, as described above. In protracted cases swelling and relaxation of the soft palate may occur. In addition to the hypersecretion of the bursa pharyngea, which presents the appearance of pus or crusts in the neighborhood of its outlet, cysts which have formed in it may at times be visible, producing rounded prominences varying from the size of a pea to that of a hazel-nut; they have a yellowish-red color and can be compressed with the probe. In this form of bursal inflammation the patient feels, as it were, the presence of a foreign body, irritation and pain in the nasopharynx, and pain may also be felt in the head.

In the condition spoken of as rhinopharyngitis sicca the dried secretions cover the mucosa of the nasopharynx extensively, in some places forming a mere film that gives the mucous surface a varnished appearance, in others adhering in the form of crusts, often of great extent and thickness. This condition does not necessarily indicate atrophic rhinopharyngitis, as when the dry coat of secretion is removed one may find the mucosa even hypertrophic; so that rhinopharyngitis sicca is not an anatomical variation of chronic catarrh of the nasopharynx, but merely so named from the dry appearance of the mucous surface. It is, however, most commonly found with the atrophic form of chronic catarrh of the nasopharynx. This often accompanies atrophic rhinitis, but may exist independently of it. It is characterized by the pale appearance and thinness of the mucous membrane which become apparent after the pharyngeal vault has been cleansed of secretions. In atrophic catarrh no trace of lymphoid tissue is found in the region of Luschka's tonsil, as this structure entirely atrophies.

Diagnosis.—The affection most liable to be confounded with chronic rhinopharyngitis, though often itself a cause of it, is disease of the posterior ethmoidal cells or sphenoidal sinus. The secretion from these cavities flows backward and dries on the pharyngeal vault, or lodges in the choanæ, or covers the Eustachian orifice.

The diagnosis is difficult. In sinus disease, after removal of the secretion, the nasopharynx seems normal unless there be a coexisting rhinopharyngitis. In empyema of the sinuses pus may be seen flowing down along the septum in the olfactory fissure, while the middle turbinal is swollen and chronically inflamed. In chronic catarrh of the nasopharynx the appearance of the nasal fossæ is either normal or characteristic of a chronic rhinitis. Empyema of the posterior ethmoidal cells or sphenoidal sinus is accompanied by the severe pain described under these affections, while the nervous symptoms of chronic catarrh of the nasopharynx are vague and less pronounced.

It is possible to mistake adenoid growths or other tumors of the nasopharynx for chronic rhinopharyngitis, but posterior rhinoscopy will reveal their widely different features. If this cannot be used, palpation of the nasopharynx must be resorted to. In chronic rhinopharyngitis it is possible for accumulated secretions to simulate the symptoms of nasal occlusion caused by adenoid growths, but they are very seldom present in sufficient quantity to cause any obstruction to breathing.

Syphilitic disease of the nasopharynx may cause great destruction in its tertiary stage, while the patient and his physician, if the latter do not use posterior rhinoscopy, may believe that only a chronic catarrh exists. If pains be not taken to remove all secretions and crusts from the nasopharynx, even posterior rhinoscopy may not reveal the existing ulcerations. Deep tertiary ulcers on the posterior surface of the soft palate may escape observation because of difficulty in getting an image

of this region in the mirror. If the latter be bent so that it is attached to its handle at a right angle, this obstacle is removed and the part in question can usually be seen. The main reliance in distinguishing syphilis of the nasopharynx from chronic rhinopharyngitis is posterior rhinoscopy, unless other symptoms of syphilis be manifest.

Prognosis.—The disease may extend over a period of many years, but is not dangerous to life, and, contrary to the popular belief, which is fostered among the laity by designing charlatans, there appears to be no tendency for it to extend downward and eventuate in pulmonary tuberculosis. When the affection has lasted many years it is doubtful whether it is often cured; but in the majority of cases caused by nasal occlusion removal of the obstruction will greatly relieve, if not cure, the disease in the nasopharynx.

Treatment.—The prophylaxis includes whatever tends to increase the individual's resistance and bodily nutrition, especially the correction of the so prevalent underfeeding due to hurried meals. Cold showers and frictions greatly lessen the tendency to exacerbations, which are apt to perpetuate the disease. Even if it be troublesome to him, the patient should be enjoined to change his underclothing to meet the changes in weather, and not to go about sweltering in woollen undergarments in summer, imagining that he is taking especial care of himself, while he is really making himself tender and weak and more liable to colds. It is impossible to avoid exposure to sudden changes of temperature, but the evil effects of overheated rooms can be mitigated by keeping the air moist, and those afflicted with dry catarrh will find it of benefit to hang a wet blanket in the sleeping-room. Those working in dust should be urged to wear a respirator, though few can be induced to make use of these for any length of time. In the local treatment the matter of first importance is the complete removal of secretions and crusts. These can be softened by means of a nasal or postnasal spray of oleum petrolatum album, or more simply by having the patient drop frequently into the nose from ten to twenty drops of fluid vaseline. This is carried back by the air-current, and spreads over the nasopharynx, if the patient be told to snuff the oil back. The thick fluid vaseline stays much longer in contact than the thin oleum petrolatum album. After the secretions are softened by the oil they must be washed away, and for this purpose the postnasal syringe is useful. The objections to it are that it forcibly floods the nasopharynx with fluid, which is liable to enter the Eustachian tube and middle ear, with resulting otitis, and that when the postnasal syringe is used the patient is apt to lift his velum so as to shut off much of the nasopharynx from contact with the fluid employed. The nasal douche is even more dangerous to the ear, and does not wash the vault of the pharynx, where most of the secretion lodges. Postnasal sprays have not sufficient force to wash away discharges as tough as those found in postnasal catarrh. The nasal irrigating tube described in earlier parts of this work is the

most efficient device for cleaning the nasopharynx with safety and a minimum of discomfort (Fig. 102). The patient easily learns to pass it back through the nostril into the nasopharynx, and its minute streams have enough force to remove all discharge without endangering the middle ear. The instrument is called Freer's nasal irrigating tube, and consists of a straightened hard-rubber Eustachian catheter with three small holes one-sixty-fourth of an inch in diameter bored through one wall of the tube near its end, while the usual orifice is closed. It can be attached to any irrigator or fountain syringe. One of the best fluids for a wash is a watery solution of potassium permanganate in the strength of one grain to a half-pint of water. The patient should be told to breathe through his mouth while irrigating, so that the fluid will not run down into the larynx and make him cough. The solutions used should always be warm. Any alkaline wash—as, for example, sodium bicarbonate or equal parts of sodium bicarbonate with sodium chloride, one drachm to the pint of water, or Dobell's solution—may be used instead.

In addition to cleansing the nasopharynx by washing, it is usual to attempt to influence the chronic inflammation by means of astringent or stimulating applications. The amount of success from these will depend much on the more or less advanced pathological changes in the mucosa. In atrophic conditions these remedies will have but a palliative effect, and in other cases the results obtained from them are sometimes disappointing and not equal to those secured by persistent cleansing. The old-time application of a solution of silver nitrate varying in strength from ten to sixty grains to the ounce will be found beneficial in many cases, and astringent or stimulating sprays, either aqueous or oleaginous, are often desirable. When there are enlarged follicles without great congestion, and when the parts remain moist, great benefit may be derived from the insufflation, two or three times a week, of two or three grains of a powder consisting of berberine muriate one part and sugar of milk or acacia two parts. For excessive secretion, either here or in the nares, terebene is beneficial in the proportion of about ten minims to the ounce of oleum petrolatum album, combined or not with other substances, as seems desirable.

If one desire a decidedly stimulating effect, as in pharyngitis sicca, whether due to the atrophic or hypertrophic form of catarrh, iodine has often a beneficial influence. It can be used in the form of liquor iodinii compositus, pure or diluted with one-half water, and is to be applied with a swab. It is decidedly painful, and it is well to begin with a weak strength, about one part to three of water.

In isolated catarrh of the bursa pharyngea the secreting furrow may be cauterized with silver nitrate fused on a probe, and bridges of tissue covering hidden pockets should be divided, together with existing cysts, with a small knife, introduced with the rhinoscopic mirror or with

the finger as a guide. The region of the bursa may subsequently be scraped with a curette introduced through the nose while the finger in the nasopharynx guides it.

NASOPHARYNGEAL DEAFNESS.

Morbid changes in the nasopharynx, particularly when near the orifice of the Eustachian tube, frequently involve the latter and extend to the middle ear, affecting the hearing, or else by closure of the Eustachian orifice they produce deafness by interfering with the ventilation of the tympanic cavity.

Etiology.—Acute inflammation of the mucous membrane of the nasopharynx, whether idiopathic or occurring with the acute infectious diseases, such as scarlatina, measles, or influenza, or with secondary syphilis, is liable to lead to acute otitis media, either catarrhal or, most often, suppurative, with perforation of the drum-membrane. In these cases the morbid process extends by continuity up the mucous lining of the Eustachian tube to the middle ear. The hearing is usually completely restored when the otitis media has run its course, but severe inflammation may produce total and permanent deafness, with sloughing of the drum-membrane, loss of the ossicles, and destruction of the labyrinth. In milder cases chronic suppuration of the middle ear and impaired hearing may result. In the same manner chronic catarrhal processes in the nasopharynx may extend from the throat to the middle ear, leading to chronic otitis media, with resulting sclerosis, fixation of the ossicles, and deafness, which may gradually increase until the patient becomes very hard of hearing. This is especially true of the atrophic form of rhinopharyngitis. Therapeutic attempts, such as passing bougies into the Eustachian tube, forcing pus or infectious material into the middle ear by the Politzer air-douche or catheter, or water into the tympanic cavity by a nasal douche or syringe, may cause otitis media of the acute and often suppurative variety.

It should not be forgotten that either acute or chronic middle-ear catarrh is at least as often an independent affection as it is the result of throat disease, and that it is frequently attributed to this on the *post hoc ergo propter hoc* principle. The impaired hearing accompanying adenoid vegetations, however, is a pure type of nasopharyngeal deafness, in which the middle ear may be anatomically normal, and hearing impaired merely as the result of pressure on the Eustachian tubes by adenoid masses or their closure, as these lie against their lumina. This condition stops the entrance of air into the tympanic cavity, so that what remains in it is soon absorbed and the drum and ossicles forcibly drawn inward, thus crowding the stapes rigidly into the oval window. In some cases this is accompanied by a discharge of serum into the tympanic cavity. If this last long enough, the rigidity of the ossicles may become chronic and some deafness remain permanently, even if the adenoid tissue be

removed; but it is surprising how long—even months and years—the drum can remain drawn inward and yet hearing be perfectly recovered in a few days, as soon as ventilation of the middle ear is restored by operations removing the adenoid tissue. In some cases the obstacle to restoration of hearing is permanent fixation of the stapes in the oval window, in others it is contraction of the tensor tympani muscle.

Swelling of the mucosa of the lumen of the Eustachian tube in post-nasal catarrh, and paresis of its opening muscles, the tensor and levator palati, may have the same effect in closing it as adenoid vegetations, and similarly cause deafness in a purely mechanical manner, without any, or but slight, catarrh of the middle ear or damage to its structures; so that, even if these states have lasted for a long time, catheterization of the Eustachian tube, with insufflation, may have rapid and gratifying results. Unfortunately, these cases are much rarer than those of middle-ear catarrh with resulting sclerosis.

Symptoms.—In the acute form the aural complication is often announced by intense earache, increase of fever, and perhaps vomiting and dizziness. Finally perforation of the drum-membrane occurs, with discharge of pus and great relief of the symptoms, or the affection subsides slowly without suppuration. In the milder acute cases the disease follows the latter course.

In infants the first intimation of complicating inflammation of the ear is often a discharge of pus or serum from it, as the symptoms may be very mild and the child merely more restless than usual. In other cases the symptoms are of a general nature, and do not lead one to suspect ear disease. When the disease leads to chronic deafness the onset of the symptoms may be very insidious. Perhaps the first notification that the patient has is a slight feeling of fullness in the ear, or more often subjective sounds at first not accompanied by deafness. This soon sets in, however, and, getting better or worse by turns, may at last reach a high degree. The tinnitus aurium may be distracting. In children with deafness from adenoids the parents' complaint is usually of seeming lack of attention. In other instances the deafness is first noticed in school.

Diagnosis.—To distinguish between aural affections resulting from disease of the nasopharynx and those which exist independently is not always possible. Middle-ear catarrh may coexist with disease of the nasopharynx, and yet not be caused by it. In other cases an acute rhinopharyngitis may soon pass away, while the middle-ear catarrh persists and becomes chronic.

In little children the diagnosis of the acute variety of otitis accompanying acute rhinopharyngitis is often not made until pus flows from the auditory canal. The actions of these patients seldom call attention to the ears, because, though some will put their hands to them as if suffering from earache, usually all that is noticeable are general symptoms, such

as increase of fever, vomiting, great restlessness, and at times convulsions, symptoms which do not call attention to the ear. In all acute colds or infectious diseases in children the ear should be inspected, whether or not there be complaint of earache. In the majority of cases of acute middle-ear catarrh in young subjects the drum-membrane will present as a deep red surface, so swollen that the malleus and other details are not visible. The membrana tympani may be so thickened that it will not bulge; in other and milder cases it will be rounded out by the distending fluid in the middle ear. After perforation occurs pus or mucus will be seen in the meatus.

Those cases of deafness accompanying adenoid vegetations in many instances show merely a retracted and at times injected drum-membrane; in others there are the appearances of a catarrhal otitis media. When these conditions are found in children, adenoid vegetations should be thought of as the probable cause, even if the patients be not mouth-breathers, as adenoid vegetations too small to obstruct breathing may cause chronic deafness. This is in most cases due to enlarged Luschka's tonsil.

Prognosis.—Otitis media, whether catarrhal or suppurative, accompanying acute rhinopharyngitis, in the majority of cases results in perfect recovery, but in a large number chronic suppuration of the tympanic cavity remains, while the catarrhal cases may not recover with the rhinopharyngitis causing them, but lead to chronic sclerosis and deafness.

Treatment.—The suppurative form of otitis media following acute rhinopharyngitis requires prompt paracentesis of the drum-membrane as soon as there is pus in the tympanic cavity. This usually gives prompt relief.

The details of treatment are more fully set forth in works on diseases of the ear, and the treatment itself should be carried out by an experienced aurist.

CHAPTER XVI.

HYPERTROPHY OF THE PHARYNGEAL TONSIL.

Synonymes.—Hypertrophy of Luschka's tonsil, adenoid growths in the vault of the pharynx.

IN 1655 Schneider discovered the pharyngeal tonsil, but Luschka first gave it its name in 1868. The enlargements of this organ have such an important bearing on the health of the individual that their description forms one of the most important chapters in laryngology. Deafness, deformities of the chest and of the upper jaw, displacement of teeth, interference with speech, and mouth-breathing, with its train of injurious consequences, are all symptoms of the disease. Fortunately, its treatment is so satisfactory that in most cases one can expect to bring about complete recovery unless the disease has been allowed to become chronic.

Etiology.—One or repeated attacks of rhinopharyngitis with acute swelling and inflammation of Luschka's tonsil are the commonest causes of adenoid vegetations. In some cases, after an inflammation of the pharyngeal tonsil has passed off, even if it be a first attack, the tonsil, hitherto normal in size, remains permanently large, so that the symptoms of adenoid vegetations set in suddenly. Frequently the pharyngeal tonsil becomes permanently enlarged only after it has repeatedly been the seat of inflammation. Luschka's tonsil, like the faucial tonsils, is merely a lymphatic gland, and it responds to infectious agents by inflammation, rarely by abscess, and often by chronic hyperplasia, as do other lymph-glands. Chronic hyperplasia predisposes decidedly to tubercular infection of lymphoid tissue, whether in Luschka's tonsil or a cervical or inguinal lymphatic gland, so that tubercular infection of adenoid vegetations may be secondary to the enlargement of Luschka's tonsil, or the tubercle bacillus may cause its enlargement primarily. The former condition is probably the more frequent.

Next to acute infections of the pharyngeal tonsil, chronic nasal or postnasal catarrhs, especially the purulent ones of childhood, are liable to induce its hypertrophy, as similar states—for instance, chronic eczema—may lead to enlargement of lymphatic glands elsewhere. In other cases the pharyngeal tonsil gradually enlarges by means of a chronically increasing hyperplasia, without local source of infection. Similar conditions are seen in the lymphatic glands in other parts of the body.

Adenoid vegetations constitute a disease of childhood. The condition may persist into adult life, but does not originate after puberty, as normally the pharyngeal tonsil atrophies at this period, so that even

adenoid vegetations may disappear by absorption at this time. They are seldom seen before the second year, and do not properly constitute a disease of infancy, but begin to be common after the second year and up to the twelfth and fifteenth. Enlargement of Luschka's tonsil may, however, occur as early as the first month of life, and is not rare up to the twentieth year.

Adenoid vegetations are among the commoner diseases,—in fact, are found in about the same proportion of cases that enlarged tonsils are. In most cases enlargements of the faucial and pharyngeal tonsils coexist, and it is more usual to find the pharyngeal tonsil hypertrophied and the faucial ones normal or but slightly changed than to find a normal nasopharynx with enlarged tonsils. It is a common practice to remove the faucial tonsils and ignore the more injurious pharyngeal one,—a practice giving the patient but slight or no relief, so far as breathing is concerned, and injuring the reputation of the operator. As they are among the chief causes of acute inflammations of the pharyngeal tonsil, acute infectious diseases, especially scarlatina, diphtheria, measles, and whooping-cough, often leave adenoid vegetations as a sequel.

Climate has a moderate influence as a predisposing cause, and adenoid vegetations are common in regions with extremes of temperature, but the disease exists in all parts of the world. The scrofulous diathesis has been assigned as a cause, but many observers now think that it is the result of chronic rhinopharyngitis with adenoid hypertrophy rather than a cause of these conditions, and that the first influence producing the scrofulous state is chronic catarrh of the nasal cavity and postnasal space, leading to the eczema of the upper lip and nostrils and the enlargement of the lymphatic glands and pharyngeal tonsil common to scrofulous children. Nevertheless, the term scrofulous diathesis has its justification, as the conditions described chiefly occur only in children with little resistance to infectious catarrhal affections of the upper air-passages and who are prone to enlargement of the lymphatic structures, with secondary tubercular infection in consequence. The influence of syphilis in producing adenoid vegetations is uncertain. They are common to all races of men.

Pathology.—Normally, adenoid or, as it is also called, lymphoid tissue is found in abundance throughout the nasal and pharyngeal mucosa, but in certain regions it shows a tendency to accumulate in masses and form what is called a tonsil. Thus there are the lingual tonsil, the faucial tonsils, and the one under consideration,—the pharyngeal tonsil. This is really a structure of childhood and early youth, as after these periods there is rarely enough adenoid substance left to create a tonsil. As a rule, the accumulation of adenoid tissue in the pharyngeal vault extends from the upper border of the choanæ to the tubercle of the atlas, and laterally from one Eustachian tube to the other. It does not end abruptly at its borders, but merges insensibly into the surrounding

mucosa. At its most prominent portion, just back of the choanæ, the lymphoid tissue is divided into two portions by a deep vertical antero-posterior fissure, the recessus pharyngeus medius. On either side of this are from three to four parallel fissures which enter the adenoid substance and often branch there into minor ones, so that a single fissure seen on the pharyngeal vault usually leads into a complicated system of recesses in the adenoid mass. These chief fissures may be crossed by transverse ones which subdivide the pharyngeal tonsil into smaller areas. The surface of the pharyngeal tonsil thus acquires an appearance like that of miniature cerebral convolutions. The description of the normal Luschka's tonsil leads to an understanding of the appearances of diseased ones. A number of these retain the general shape of the normal Luschka's tonsil,

FIG. 163.



Rhinoscopic image of an enlarged Luschka's tonsil. (Heymann.)

but exceed it greatly in size, jutting into the nasopharynx from its roof in the shape of a well-defined lump. This variety of enlarged pharyngeal tonsil is generally of firm consistency, in some cases almost fibrous in character. It is occasionally seen in young adults, but occurs frequently in children.

In another group of cases the enlarged pharyngeal tonsil does not form a well-defined, firm tumor, but is found in the shape of soft outgrowths which depend from the pharyngeal vault like polypi. To these the name of vegetations is well applied. This variety of adenoid vegetations is generally soft and friable, and is apt to occur with those pharyngeal tonsils which are subdivided by numerous transverse fissures and possess little connective tissue, so that from lack of firmness the separate parts yield readily to the force of gravity and present in berry-

like or polypoid shapes. In rare instances softened, cheesy deposits of tubercular origin are found in the adenoid masses, but almost invariably these present the naked-eye appearances of healthy lymphoid tissue of a light pink or bluish color and semi-translucent nature. Though the above two types are those generally found, the form and position of the adenoid masses show great variations. Thus there may exist a firm, smooth outgrowth like an arch placed between the Eustachian orifices and compressing them, while it does not descend far enough to interfere with nasal breathing. In other cases the firm variety of enlarged pharyngeal tonsil is seated low down on the posterior pharyngeal wall, extending a short distance upward from the level of the velum, while the pharyngeal vault is comparatively free. The soft variety with dependent vegetations has a strong tendency to invade the posterior nares, so that polypoid masses of adenoid tissue grow within the posterior ends of the nasal fossæ and obstruct breathing. In many cases the adenoid tissue has a predilection for the lateral regions of the nasopharynx, blocking the Eustachian tubes and fossæ of Rosenmüller. A small adenoid mass may be so situated as to interfere with the function of the Eustachian tube, and deafness may occur without impaired breathing through the nose.

Histologically, the conditions are the same as are found in the normal pharyngeal tonsil,—viz., lymphoid elements in large quantity. The surface of the adenoid growth is for the greater part covered with ciliated epithelium; in places pavement or cuboid epithelium is found. Beneath the epithelial layer lies the basement membrane, and below this is a more or less dense connective-tissue reticulum closely packed with round cells and containing numerous large lymph-follicles and the ducts of the mucous glands. The acini of the latter lie in the submucous layer of the connective tissue below the layer of adenoid tissue. Below the submucous region there is the dense, firm connective tissue of the basilar fibrocartilage of the pharyngeal vault.

Miliary tubercles, tubercular, softened, cheesy masses with bacilli, and giant cells have been found in the pharyngeal tonsil, and there is no doubt that its tubercular infection is far more frequent than is supposed, though still rather rare. Considering the importance assigned at present to the entrance of tubercular infection into the organism through the lymphatic structures of the fauces and pharynx, and its penetration of the lymph-glands of the neck and thorax through these channels, the possibility of adenoid vegetations being tubercular, and a possible source of pulmonary phthisis or tubercular meningitis at some future time,

FIG. 164.



Adenoid vegetations hiding the upper part of the choanae.

is one more important reason for their radical removal and an argument against leaving any portion of them behind, as is apt to occur with certain popular and imperfect modes of operation. It is asserted that more cases of pulmonary tuberculosis are due to entrance of the bacilli through the pharyngeal or faucial tonsils than to their invasion of the body by inhalation into the lungs, and that the tubercle bacillus penetrating the lymph-glands in childhood lies dormant until the usual time for the appearance of phthisis. Dieulafoy produced tuberculosis seven times in guinea-pigs inoculated with portions of thirty-five extirpated pharyngeal tonsils.

Pathological conditions accompanying enlargement of the pharyngeal tonsil are seen in the upper jaw, the thorax, and the nose. The upper jaw is apt to present what is known as the high-arched appearance, the hard palate being unusually concave and reaching far upward, while the jaw is narrow from side to side, and the alveolar arch ends in a V in front instead of an even curve. This throws the teeth out of line, so that, for lack of room, the central incisors form a projecting angle and are apt to cross each other. The edges of the lateral incisors are not placed transversely, but antero-posteriorly, while the canines appear in a plane above the incisor teeth. The teeth growing in the *pars incisiva* of the upper jaw project beyond the incisors of the lower jaw to an abnormal extent. The shape of the latter remains normal. These changes are noticeable in the first set of teeth, but much more so during second dentition. The incisor teeth of both the first and second set are prone to decay early. Children of from twelve to fourteen years of age have been seen with their second incisors entirely decayed. It must not be supposed that these changes in the upper jaw are invariable and exist in all cases of adenoid vegetations; there must be some individual predisposition, as many people with this affection have normally shaped upper jaws and perfect teeth. The reason for the deformity is lack of development of the nasal cavity. Adults are seen whose nasal fossæ, though normal in shape, have remained more or less infantile in size as the result of adenoid vegetations in childhood. These cases have the high-arched palate, and cannot obtain enough air for comfortable nasal respiration through their small but normally formed nares. This condition is irremediable, unless respiration be made free by resection of one or more of the turbinated bones.

The nostrils are sometimes found narrowed as a result of disuse of the muscles of the *alæ nasi*, but the most common nasal deformity due to the presence of adenoids is narrowness of the posterior portion of the nasal fossæ. Their anterior portion is generally normally roomy, but in the back of the nose the turbinals approach close to the septum, while at the same time a fold of mucous membrane often closes the upper arch of the choanæ. This narrowness of the bony and soft parts forming the choanæ is found in quite young children with enlarged pharyngeal tonsil,

and forms an important feature in the operation for its removal, as, if these deformities be not corrected at the time of operation, the mere removal of the adenoid tissue in the nasopharynx will not give any, or but imperfect, relief.

Deviations of the septum are often found complicating enlarged pharyngeal tonsil, especially in those nearing or past puberty; but in little children one finds the septum straight and the nasal fossæ clear, except at their posterior portion. The thorax, though in most cases normal in shape, may show changes due to the nasal obstruction and difficult mouth-breathing. Though in the daytime the mouth forms a widely open channel for air, unless enlarged tonsils be a complication, at night, in sleep, the tongue is apt to sink backward and obstruct the larynx, and if this condition be complicated by enlarged faucial tonsils the obstruction to breathing may be very great. Children with this combination of enlarged pharyngeal and faucial tonsils breathe in a most alarming way during narcosis, and asphyxia seems imminent at any moment. In some cases the obstruction to breathing is quite enough to deform the thorax when continued for long periods. The usual type of chest resulting is the one called emphysematous. In this the upper part of the thorax is distended, while the lower parts do not expand properly; in other cases the children are flat-chested or have pigeon-breast. Whether flat chest, deformities of the spinal column, lordosis, kyphosis, and scoliosis are, as alleged, due to the adenoid disease or the result of school-benches and imperfect physical development is a question.

Symptoms.—The most striking symptom of adenoid vegetations is the obstruction to nasal respiration. In the great majority of mouth-breathing children such growths, and nothing else, cause this symptom. So frequently is this the case that some rhinologists attempt to diagnose the existence of adenoid vegetations from this symptom alone; but, though other causes of nasal obstruction in children are rare, they occur with sufficient frequency to need consideration. Thus, a number of mouth-breathing children will be met in any of the larger clinics whose defective respiration is due to hypertrophic rhinitis or nasal mucous polypi, while no trace of an enlarged Luschka's tonsil exists.

The nasal obstruction in enlarged Luschka's tonsil is in most cases lasting and unvarying, but in a number of them is subject to exacerbations and remissions. These remissions are apt to lead the parents and even the physician to think that the child is outgrowing its affection. In the milder cases mouth-breathing may occur only during sleep, while in the daytime the child has nasal respiration. In the severer cases the mouth is held open in the daytime, and the child acquires the peculiar stupid and listless expression known as the adenoid face,—an expression which is, however, not limited to adenoids, but is found with any nasal obstruction in children.

The second striking symptom due to adenoids is snoring. It may

attract more attention than the mouth-breathing, and be loud enough to annoy others and greatly distress the parents. It is especially loud if the faucial tonsils be enlarged at the same time. Under these conditions there is not only obstructed nasal breathing due to the adenoid vegetations, but the narrowing of the fauces by the enlarged tonsils and the dropping back of the tongue on the larynx during sleep cause dyspnoea that is painful to witness, and whose recurrence on successive nights alarms the parents. The snoring is probably caused by vibrations of the soft palate and perhaps of the epiglottis in the air-current. The oppressed breathing causes nightmare, so that these children are subject to nocturnal terrors. The reason why the air-current through the nose is so much more obstructed at night than in the daytime is found in the fact that mucus collects in the inferior meatus, the only nasal passage left open by the adenoids, and this condition and swelling of the posterior ends of the inferior turbinates due to venous congestion are apt to be super-added to the adenoid difficulty.

The third important symptom of adenoids is deafness. The occurrence or absence of this depends much on the shape and location of the growths. Acute inflammation of Luschka's tonsil may, as has been shown, lead to catarrhal or suppurative otitis media by direct extension of the accompanying acute rhinopharyngitis. When this occurs with an already enlarged pharyngeal tonsil, otitis media is even more likely to happen, so that many children with adenoid vegetations have recurrent attacks of running ears. The usual effect of adenoid vegetations on the auditory apparatus is, however, merely mechanical, and is due to their obstructing the Eustachian orifice. They may cause this by filling up the fossa of Rosenmüller, and creating pressure from above and behind on the Eustachian prominences, thus preventing the proper opening of the tubal orifices for ventilation of the middle ear, or portions of the vegetations may lie directly against the openings of the tubes and have the same effect. This often leads to catarrhal otitis, though more frequently it merely deprives the middle ear of its air-supply; hence removal of the adenoids restores the hearing in a few days. When the deafness has lasted a long time, recovery is not usually to be expected, though decided improvement may result. In some cases deafness is the only symptom of enlarged pharyngeal tonsil, as this may not be large enough materially to obstruct breathing, especially if the nares be more than usually roomy. When the adenoid vegetations are extensive enough to close the nasal fossæ completely (a very rare condition), aspiration of air from the middle ear must occur as a result of the vacuum produced in the nasopharynx during swallowing with a totally obstructed nose. The senses of taste and smell are lessened or arrested by adenoid obstruction.

A fourth important symptom of adenoid vegetations is change of voice. This applies especially to the pronunciation of those consonants requiring an open nasal and nasopharyngeal passage, *m*, *n*, and *ng*.

Children with adenoids sufficient to shut off the nasal cavity to a great extent from the nasopharynx will pronounce these *b*, *d*, *t*. If the nose be occluded at its anterior end, *m* and *n* can still be pronounced, as the nasal chambers act as resonators. The adenoid voice has, therefore, a peculiar dead, non-resonant quality differing from that due to obstruction of the anterior parts of the nose, which gives to the voice a nasal twang.

Among the complications of adenoid vegetations the deformities of the upper jaw, thorax, and nasal passages have been described under pathology. Another moderately frequent complication is nasal catarrh. In most children inspection of the nasal fossæ shows these to be normal or even roomy, while the turbinals are not swollen. In another type of child with adenoid vegetations there are pronounced chronic nasal catarrh, swelling of the turbinals, especially at their posterior ends, and the nasal fossæ are filled with muco-pus or crusts. These children are apt to present a scrofulous appearance. Adenoid vegetations are never associated with atrophic rhinitis, but the turbinals are often abnormally small and undeveloped. Cleft palate is frequently accompanied by adenoid vegetations. Bronchial asthma has been noticed as associated with them and disappearing after their removal. This can be understood when one considers the irritation of the larynx, trachea, and bronchi resulting from mouth-breathing,—an irritation which may result in laryngitis, tracheitis, and bronchitis. Pseudo-croup, or laryngismus stridulus, is a rare symptom of adenoid vegetations, and may result from the direct irritation of the larynx from mouth-breathing or from mucus which flows down into the larynx from the nasopharynx at night. The voice obstruction may result in paresis of the laryngeal muscles and hoarseness, on account of the greater strain thrown on the vocal cords during phonation in the effort to overcome the obstacle to sound caused by the adenoid obstruction. Children and adults with enlarged pharyngeal tonsil may be afflicted with a nervous tickling cough due to reflex irritation excited by its presence in the nasopharynx. Headache is a not unusual symptom, especially in older children and adults with such tonsillar hypertrophy, and the headaches complained of so often by school-children are sometimes explained by the presence of adenoid vegetations. The seat of the pain is indefinite, or it may be occipital, frontal, or temporal.

It is a singular fact that removal of adenoid vegetations has in some cases put a stop to enuresis nocturna, and the same result has followed the removal of other nasal obstructions. Among the nervous symptoms occasionally relieved by the adenoid operation is stuttering. Aproxia, or inability to concentrate the mind, and mental dulness have been attributed to adenoid vegetations, and certainly mental improvement in dull children has usually been observed to follow removal of enlarged Luschka's tonsil. This may be due merely to the remarkable gain in general health that often follows this, as it does the operation of tonsillotomy,—an improvement explained in various ways, but still rather

incomprehensible. Though many children with adenoid vegetations look blooming and healthy and are not retarded in their growth, the exceptions to this satisfactory state are so frequent that the physician is forced to attribute to adenoid vegetations the anæmic, ill-nourished condition of many of the patients, and it is a frequently observed fact that, after removal of the adenoids, children who have up to this time remained undersized begin to grow rapidly and even abnormally fast.

Inspection is more often possible than would be supposed, but posterior rhinoscopy generally needs to be aided by the application of a five per cent. cocaine solution to the fauces, and especially to the posterior wall of the pharynx, against which the rhinoscopic mirror impinges. When there are enlarged tonsils posterior rhinoscopy is very often impossible. In many cases the reflexes of the oropharynx in children with adenoid vegetations seem remarkably deficient, which is perhaps due to blunting of the sensitiveness of the mucosa on account of mouth-breathing. This condition is an aid to examination. When posterior rhinoscopy is possible, the pharyngeal tonsil presents the appearances described under pathology. The color of the enlarged pharyngeal tonsil is light pink, and at times it looks translucent and œdematous, at others firm and solid. The foreshortening of the rhinoscopic image makes the antero-posterior folds between the fissures of the tonsil seem mere knob-like prominences. Beyond the depending pharyngeal tonsil one sees more or less of the posterior nares, often merely the upper arched border of the choanæ being hidden. In the more marked cases the middle, and in pronounced ones the lower, turbinal is hidden from view, and all that is seen is the bottom of the lower meatus and a little of the lower part of the vomer, or possibly nothing of the choanæ. These latter cases present at first a confusing aspect, as the usual landmarks of the post-nasal space are hidden. In cases of deafness in children it is very hard to determine just how much injury to hearing a small adenoid mass is causing by pressing on the Eustachian tubes, and inspection may not make this point clear enough to be certain whether the adenoid growth is occluding the Eustachian orifices or merely happens to coexist with catarrhal otitis media without causing or aggravating it. In these cases removal of the enlarged pharyngeal tonsil must be advised, so as to eliminate its possibly bad influence on the hearing. If no improvement result, the parents are apt to feel dissatisfied unless they have been warned that an adenoid operation does not invariably improve or remove the deafness. Inspection may show the nasopharynx to be full of mucus or muco-pus, which can be seen flowing down the posterior pharyngeal wall. This condition is by no means so common as the literature of the subject would lead one to suppose, and in children with adenoid vegetations the mucous membrane of the nose and nasopharynx is more frequently in a healthy state than in a condition of chronic catarrh, so that posterior rhinoscopy generally shows the walls of the nasopharynx and the sur-

face of the adenoid vegetations free from secretion and natural in color. The surface of the removed pharyngeal tonsil is also almost invariably found free from adherent secretions, and these are very seldom discovered on the finger when it is withdrawn after an examination of the nasopharynx.

In little children, refractory ones, and those whose velum is too close to the posterior pharyngeal wall, inspection of the nasopharynx is not possible, and here its digital exploration is required. It has been stated that this is brutal and needless. If the symptoms of adenoid vegetations were such that they would unerringly announce their presence, digital examination might be unnecessary; but as various nasal obstructions not visible from in front, such as nasal mucous polypi in the choanae, or swelling of the posterior ends of the turbinals, may block the nose at its posterior part, and cause symptoms similar to those of adenoids, digital exploration is needful in order to make a differential diagnosis and determine the method of operation. Digital exploration is neither very distressing nor painful if the oropharynx and nasopharynx of the child be first sprayed with a slight quantity of a solution of cocaine. Children do not usually object to the introduction of the gag, and passing a finger into the mouth does not frighten them. In place of the gag the thumb of the disengaged hand can be used to push the cheek between the child's teeth so that it cannot close its mouth without biting itself; but children do not usually try to bite. The method of examination is described in the preliminary part of this article. The finger should first feel for the septum narium and the firm prominences of the Eustachian orifices; then the vault and rear wall of the nasopharynx should be palpated from the septum back. Some adenoids present as a firm, fleshy tumor between the Eustachian tubes, and are easily felt. The soft variety, however, is hard to feel, and slips away from the finger, so that one may imagine that the nasopharynx is free from adenoid growths unless it be palpated very gently. In this case the soft, cushion-like feeling given by the vegetations is very different from the firm, bony resistance offered by the pharyngeal vault, which is so characteristically hard that when touched it is known at once that there are no adenoids present. It is a good rule never to withdraw the finger from the nasopharynx before being sure that everything has been carefully palpated. The tendency is to relieve the child of the possible distress, and to take the finger out before a conclusion is reached. The examiner must decide not only whether adenoid vegetations are present at all, but whether they are in sufficient quantity to need operative removal. When the finger is withdrawn there will be blood upon it if there be adenoid vegetations, as they bleed when touched.

Diagnosis.—As any chronic affection causing stoppage of the nasal passages may cause symptoms not differing materially from those of adenoid vegetations, examination of the patient by anterior and posterior

rhinoscopy and, if needed, palpation of the nasopharynx are absolutely necessary to establish a diagnosis. If these means be employed an error is unlikely, whereas those who attempt to recognize the disease merely from the symptoms are liable to mistake certain other and rarer affections for the ailment.

Nasal mucous polypi, though rarely, do occur in children. If in the nasal fossæ, anterior rhinoscopy will discover them. It is only when they develop in the posterior part of the nares and grow into the post-nasal space that a question can arise in the diagnosis, as, when of large size, they may nearly fill the nasopharynx. If posterior rhinoscopy be possible, the grayish translucent polypus with its glassy surface cannot be mistaken for adenoid vegetations, especially as these hang from the pharyngeal vault, while the polypus rests on the soft palate. If the diagnosis must be made by palpation, the mobility of the polypus will serve to distinguish it; but if it be very large, so as to fill the postnasal space, the nature of the growth may become clear only after it has been removed. As both the polypus and adenoid vegetations can be brought away by the Löwenberg forceps, a failure to distinguish the two affections is not of great moment. Fibroid tumors are much harder than the hypertrophied glandular tissue; they are frequently attended by severe epistaxis, and upon being touched bleed easily and profusely. They are usually of a bright red color with blood-vessels apparent upon the surface, and, when large, cause distortion of the neighboring parts. None of these signs is observed in hypertrophy of the pharyngeal tonsil.

Prognosis.—Probably in seventy-five per cent. of the cases the gland, if left to itself, would atrophy at about the twelfth or fourteenth year; but in the mean time irreparable harm to the ear, the voice, or the general health may result. In the remaining cases the gland gradually diminishes in size, and disappears before middle life. It is important that operative measures be not too long delayed, as deformities of the upper jaw or thorax will continue to progress, and hearing perhaps become permanently damaged if relief be not prompt. As stated above, though the adenoid operation will aid in the removal of deafness, too favorable a prognosis will cause disappointment in some cases. In regard to the disappearance of mouth-breathing, predictions must also be guarded. In many cases nasal respiration is resumed in a day or two; in a large number, however, the mouth-breathing habit is so firmly established that even with free nasal passages the child goes about with its mouth open. Such patients are sometimes brought back to the physician with the remark that the operation was not complete, when anterior and posterior rhinoscopy will show the nasal fossæ and nasopharynx entirely free from obstruction. In this case it is hard to convince the parents that the mouth-breathing is merely a bad habit. In other cases intumescent rhinitis may cause it to persist, or a septal

deflection may have the same effect. When the operation for removal of adenoid vegetations is not completed through the nasal passages in the manner to be described, narrowing of the choanæ or the presence of adenoid masses within the posterior parts of the nasal fossæ may continue the obstruction to nasal respiration. After thorough removal of the adenoid tissue it does not reappear, but after the operation with the ring-knife, the most popular method in use to-day, returns of the adenoid vegetations are frequent, as their superficial parts are taken away and deeper portions often left behind.

Treatment.—The principal surgical measures in vogue at present are removal of the adenoid tissue by the Gottstein ring-knife or similar appliances, or by the use of postnasal forceps with cutting beak, of which the Löwenberg forceps is a type.

Ring-Knife Operation.—The operation with the ring-knife is most often practised, and the rapidity and ease with which it enables the surgeon to operate have given it an undeserved popularity. Though there are many modifications of the ring-knife, that of Gottstein is undoubtedly employed more than any other. The blade is attached at about a right angle to the end of the shank, which is so curved that the ring-shaped

FIG. 165.



Gottstein's ring-knife.

blade can be introduced into the pharyngeal vault, where it shaves off the growths present there as it is withdrawn. Emil Mayer (*New York Medical Record*, vol. xlv. p. 415) has designed a pharyngeal curette that is more useful for clearing adenoid tissue from the posterior pharyngeal wall and the vault of the pharynx than any curette heretofore devised. The operation is generally done without narcosis. The patient, if a child, is held on the lap of an assistant, who is seated in a chair and seizes its body and arms with one arm, which presses the child's back against his chest, while with the disengaged hand he bends back its head firmly against his breast. The operator, with the guidance of a head-mirror, presses down the tongue with a tongue-depressor, and passes the ring-knife up behind the velum as high in the nasopharynx and as far forward as possible, while the shank of the instrument presses the soft palate towards the front. The knife is then drawn backward and downward in the median line, while it is firmly pressed against the pharyngeal vault. The knife can then be returned to the region just back of the choanæ and swept backward along the lateral parts of the vault of the pharynx, so as to clear these regions of portions of the growth. After the first cut has been made the detached pharyngeal tonsil may

often be seen to sink down into the oropharynx, whence it may be retched out or pulled out by the ring-knife. It may also be swallowed or lodge in the lateral parts of the nasopharynx and appear later, perhaps through the nostrils. As soon as the knife is withdrawn the child's head should be bent over a basin to catch the freely flowing blood. The hemorrhage generally soon ceases. If the bleeding continue it may be necessary to inject cold water into the nasopharynx, and in rare cases this region has to be plugged. Preliminary applications of cocaine are useful, but not very effective. When children are very unruly and so large that they cannot be firmly held against their will, general narcosis becomes necessary. The child is anesthetized in the recumbent position to the degree of half narcosis, after which it is placed in the assistant's lap and the operation proceeded with as described.

The ring-knife operation is rapidly done, easy because mechanical in nature, usually requires no anesthetics, and for these reasons has become very popular, especially with those lacking experience in rhinology. The objections to this method are far more numerous than its advantages. As usually performed, without anesthesia, it is cruel. The nasopharynx is extremely sensitive, as is obvious to any one who considers its nerve-supply, and the pain caused by the operation is extreme. Local anesthesia does not prevent this, as it cannot act upon the tissues at the depth to which the ring-knife penetrates. The distress and nervous shock due to terror are not matters of small moment, and may leave the child timid for years. The ring-knife operation is liable to be followed by severe, prolonged, and even fatal hemorrhage, though this is much rarer than the bleedings which follow tonsillotomies. The reasons for the serious hemorrhage are the clean-cut nature of the incision made by the ring-knife and the fact that the lateral walls of the nasopharynx and the Eustachian orifices, with their rich blood-supply, are liable to be wounded in the blind gropings with an instrument which may fit the nasopharynx for which it was designed, but cannot possibly adjust itself to the many shapes of postnasal cavities encountered. This lack of fitness for varying conditions is common to most mechanical modes of operation. If the operator confine himself strictly to the median line, the result is apt to be imperfect; if an attempt be made at thoroughness, so that the lateral portions of the pharyngeal vault are scraped, there is danger of causing severe hemorrhage. The tubal prominences are especially vascular, and if projecting are liable to be wounded; the extent to which they protrude varies greatly in different individuals. The ring-knife operation is not thorough; it ignores the adenoid masses so frequent in the posterior nares and the narrowing of the choanæ so often found, and is not adapted to clearing the posterior pharyngeal wall of adenoid tissue, though this is a region in which its largest mass may be situated. The instrument is also badly fitted for removal of masses growing about the tubal orifices. It does not cut off

the adenoid tissue to a sufficient depth, so that the lymphoid tissue left behind has a tendency to sprout and replace the pharyngeal tonsil, a disposition to proliferation shared by all diseased lymphoid tissue.

It is not a matter of indifference whether or not a return occurs. The pain of the operation must be endured again, the child's terror is intensified by its recollection of the first operation, and the parents, disappointed and sceptical, will wait until the evil results of a renewal of the growth have reached a high degree before they will consent to a second operation; meanwhile great damage may have been done to the hearing or result from the mouth-breathing. It is not right to run the risk of having to perform a second operation if the first can be so done that a relapse cannot occur.

Mouth-breathing may persist after the operation with the ring-knife, as after all pharyngeal tonsil operations, even if the adenoid tissue be completely removed, but is more commonly due to portions of this tissue left behind after operation and located in the posterior nares,—portions which could not be included in the sweep of the knife,—or else the mouth-breathing is caused by narrowing of the choanæ. It is one of the chief faults of the ring-knife operation that it can only clear the pharyngeal vault and cannot reach the adenoid tissue located elsewhere.

The advocates of the ring-knife operation regard the absence of general anæsthesia which it permits as one of its great advantages, and justly so. This argument should, however, not have enough weight to induce the rejection of a thorough operation for one liable to be imperfect. The advantages of anæsthesia are absence of the severe pain caused by operations in the nasopharynx and of the deleterious nervous shock due to terror and the sight of blood. Anæsthesia enables a surgeon to perform the operation in a deliberate and thorough manner instead of in a hasty and incomplete one. Half narcosis is objectionable; therefore the anæsthesia should be profound enough to abolish the pharyngeal reflexes. This is obvious to any one who palpates the nasopharynx while the patient is under an anæsthetic. The contractions of the pharyngeal muscles, by causing folds and ridges, make the surgeon uncertain in a conscious child as to what he feels. These do not occur during insensibility, and one can accurately determine the location and size of adenoid masses that could hardly be felt in a struggling child. Ether or chloroform is the anæsthetic to be preferred. The most rapid and satisfactory anæsthesias are generally obtained with chloroform, but some children more readily yield to ether. The latter is the safer, as a considerable number of deaths from chloroform anæsthesia during adenoid operations are reported, and children with their respiratory passages choked with enlarged pharyngeal and faucial tonsils are especially bad subjects for general anæsthesia. The objections to ether are the difficulty of abolishing the pharyngeal reflex sufficiently to stop retching, which is very embarrassing to the operator, and the increase of the secretions in the

throat caused by this anæsthetic. When there are large tonsils and breathing is greatly obstructed, it is better to use ether; when oral breathing is free, chloroform is preferable. Whichever anæsthetic is used, the child must be watched with unusual care, and its breathing should be under constant observation. If there be cyanosis the anæsthetic must be promptly suspended. The most satisfactory operation is that with

FIG. 166.



Mackenzie's modification of Löwenberg's forceps.

the Löwenberg forceps, or preferably Mackenzie's modification. Necessary for its performance are a mouth-gag, preferably Allingham's, a pair of large- and one of small-bladed Löwenberg forceps, and an Ingals nasal bone-forceps, for passage through the nares. The distance from the end of the cutting edge of the Löwenberg forceps to the angle in the shank of the blades is one and one-half inches. The patient is placed on his left side, close to the edge of the table, so that the left arm, which is underneath, is passed behind his back. The face looks downward at an angle of about forty-five degrees. This enables the blood to flow out of the mouth and nares by gravity and keeps it from entering the larynx. The operator sits on a low chair, and passes the index-finger of the left hand up behind the velum as a guide to the forceps, while the patient's mouth is held widely open with the gag. The forceps follows

FIG. 167.



Allingham's mouth-gag (one-half natural size).

the finger and, keeping in the median line, is opened as widely as possible, so as to seize the bulk of the adenoid mass at the first introduction. It is then withdrawn, cleaned of adherent flesh, and reinserted. This time it is used to cleanse the fossæ of Rosenmüller and carefully pluck away all tissue near the tubal prominences. The small-bladed forceps is often better in this region than the large one.

The forceps follows behind the finger-nail and, guided by the tip of the finger, seizes the separate pieces of adenoid tissue. This yields readily to the pull of the instrument, while the submucous tissue offers a stronger resistance, so that the operator is warned when he has passed beyond the boundaries of the growth. With care he can avoid seizing the Eustachian tubes, which must frequently be palpated to keep their location in mind.

ations into the antrum of Highmore by perforation of its posterior wall, while other portions of these tumors cause swellings, which appear above the zygomatic process, in the temporal region, and beneath the malar bone. Parts of these neoplasms may enter the orbit by means of the sphenomaxillary fissure, or advance into the frontal and sphenoidal sinuses or the ethmoidal cells by way of the nares. The deformity caused by the invasion of these cavities is often extreme. The lower jaw appears spherically distended, the eye bulges forward, while a tumor appears above and below the zygoma. The deformity becomes frightful in those cases in which the growth extends forward into both nasal fossæ and orbits. In such cases the nasal bones are wedged far apart, broadening the bridge of the nose and forcing the eyes asunder, while the orbital prolongations drive them from their sockets. In these instances a portion of the growth may appear externally and protrude from the nostril and orbit. The above type of deformity is called frog-face. An early symptom of retromaxillary tumors may be not nasal occlusion, but distention of the upper jaw. Those tumors originating on the basilar process of the occipital bone send their prolongations into the sphenoidal, frontal, and maxillary sinuses and the ethmoidal cells, usually by penetration and widening of their natural orifices, but also by causing pressure atrophy and absorption of their bony walls. The prolongations into the ethmoid bone are the most dangerous. In the course of time they may enter the cranial cavity through perforations caused by absorption of the thin structure of this bone, and then lead to meningitis or, more rarely, to brain-abscess. These outgrowths from the neoplasm belong to its later stages, and are generally characteristic of neglected cases.

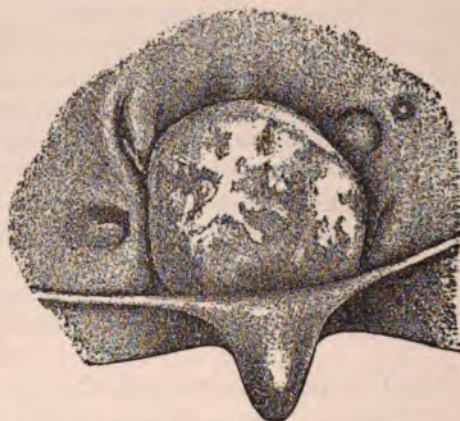
Those growths found on the posterior wall of the nasopharynx generally have no prolongations. They originate on the prevertebral tissues, form rounded, easily enucleated tumors, and are the most benign of the fibromata of the rhinopharynx. In rare cases they penetrate the lateral region of the neck by means of extensions. Fibroid tumors of the nasopharynx are hardly ever seen until they have attained a considerable size. Inspection of the nares shows in one or both a finger-like prolongation of the neoplasm, or merely that the posterior end of the nasal fossa is occluded by an obstructing mass. In rare cases the tumor can be seen to project from the nostril as an ulcerated growth, its color varying from pink to dark red.

Inspection of the pharynx shows the soft palate pushed downward and forward if the tumor be of sufficient size. Posterior rhinoscopy reveals a large, smooth mass filling the nasopharynx and hiding it and the choanæ from view. The growth may present a clean appearance or be covered with muco-pus, mucus, or bloody crusts, and display superficial ulcerations. In other cases the secretions are present in such amount that they cover up the growth, which becomes visible only when they are

washed away. In a number of cases a portion of the tumor can be seen protruding into the oropharynx, and may be directly inspected. When washed free from adherent secretions the color of the tumor in the nasopharynx is dark pink or red, and not translucent, as are mucous polypi, as a rule.

Palpation with the probe in the nose or nasopharynx will offer a firm and elastic resistance, while the finger in the nasopharynx will encounter the same characteristics. The probe is to be used with caution, as severe bleeding occasionally follows its use and may put a stop to further investigations. The tumor is but moderately movable or may be found firmly fixed by adhesions and prolongations. Prolongations into the orbit may announce themselves at first by inducing optic nerve atrophy, or by displacing the globe in various directions, causing diplopia. Pro-

FIG. 168.



Fibrosarcoma of the postnasal space of a seventeen-year-old youth. Right tubal orifice displaced forward, left compressed. The tumor is for the most part covered with tough yellowish secretion. (Mikulicz and Michelson.)

longations into the cranial cavity may be difficult of diagnosis, and for a long time set up obscure symptoms, which become definite when there is intracranial pressure.

Severe neuralgias may be occasioned by pressure of the growth on the second and third divisions of the fifth nerve as it passes through the foramen ovale or rotundum. The pain may be agonizing and be located in the upper or lower jaw, or both. If the eye be not dislocated and pain be felt in all three branches of the fifth nerve, the Gasserian ganglion is involved, and the cranial cavity has therefore been entered by the tumor; but if there be forward displacement of the eye, the neuralgia may be due to extracranial pressure on all three divisions of the fifth nerve. The motor nerves of the eye-muscles are also liable to paralysis from compression, but disturbances of the motions of the eye are more often due

to displacement of the globe mechanically by the advancing tumor. Adhesions are apt to result from unsuccessful attempts at removal of the growth. The discovery of these and of the separate prolongations of the tumor is often not possible, except during operations for its removal.

Diagnosis.—The differential diagnosis from malignant sarcoma may not be possible even with the microscope. Sarcomata are less apt to form a well-defined tumor than fibroid tumors of the nasopharynx, and tend to invade the neighboring tissues, not by displacement, but by directly entering them with their histological elements. Mucous polypi may become so large as to fill the entire postnasal space. They are, however, seldom red, but usually of a characteristic glassy gray and translucent, and are far more freely movable than fibromata. The prolongations of the latter into the nares, however, may appear œdematous and translucent, and so be mistaken for mucous polypi.

One might possibly confound hypertrophy of Luschka's tonsil with fibromata, from which it will be differentiated by the age of the patient, its slower growth, and by its having a lighter color, more irregular surface, and less density. Adenoid vegetations in the vault of the pharynx do not bleed so profusely when handled as the fibromata, and are soft, irregular, and occur at an earlier age.

Prognosis.—The growths tend steadily to increase in size, and, unless recognized and removed, will in most cases prove fatal in the course of four or five years. Even when removed there yet remains a strong tendency to recurrence; but, fortunately, if they can be kept in check until the patient has attained the age of from twenty to twenty-five years, there is a disposition to spontaneous arrest of development.

Treatment.—The use of caustics and the attempt to reduce the growth by the application of other chemicals have been abandoned in the treatment of fibrous tumors of the nasopharynx. The galvano-cautery is employed for destruction of nasopharyngeal fibromata, and has been used in the form of a large porcelain burner or the cautery knife. With the former several sittings are needed, the large sloughs formed are liable to cause sepsis and lead to dangerous hemorrhages, and the great heat developed is apt to burn neighboring structures and cause adhesions which add enormously to the difficulties of radical removal. Excisions of pieces with the cautery knife or punctures with pointed electrodes have been followed by shrinkage of the tumor. The best method outside of operative removal is that by electrolysis. By means of a carbon rheostat and an electric light in circuit, in connection with a series plug, the direct, not alternating, street current, usually having one hundred and ten volts, can be used, and will furnish a current equalling that obtained from fifty-five very active cells, a larger battery than is ordinarily assembled. To furnish the required current from a battery at least thirty cells, and probably forty or more, will be needed, unless the battery be very active. Currents up to three hundred and forty milliampères have been used, but

anything above seventy or eighty will make a general anæsthetic necessary on account of the great pain produced. When currents of this high ampèreage are used the proximity of the brain is to be considered, as enough of the electricity may traverse it to cause syncope. With the very strong currents mentioned the growth can be destroyed in a few sittings, and the danger of sepsis from sloughing is less than when weaker ones are employed, as the tumor is cast off more rapidly. This danger is one of the drawbacks of electrolysis when employed for the removal of nasopharyngeal fibromata. Gangrenous and phlegmonous processes may accompany the casting off of the deep sloughs, and a fatal meningitis is recorded. A good strength for most cases is from forty to sixty milliampères. Currents of even this moderate strength are very painful, but good local anæsthesia and very gradual introduction of the current will do much to moderate the pain. One or more needles may be used for the negative pole, while the positive electrode may be a large sponge applied to the back, the so-called monopolar method, or preferably a needle inserted into another part of the growth, the bipolar method. The needles may be introduced through the nose or nasopharynx, and all but the exposed ends must be well insulated. The current may be continued for from ten to fifteen minutes. The operation must not be repeated under from ten days to two weeks, or even longer, as the sloughs must have time to separate before new ones are created. This will diminish the danger of septic processes, which can also be minimized by cleansing irrigations of the nares and nasopharynx with mild antiseptic solutions and the free insufflation of iodol. A long time is usually required for treatment, even one hundred sittings being needed in some cases. When very strong currents are used ten operations may suffice.

When the patient will consent to operative removal of the growth this method is preferable, unless extensive adhesions be present and occasion a difficult and bloody operation, or the great size of the tumor makes it desirable to reduce it before attempting to take it away with instruments. The operations for ablation of the tumor are of two types: the first includes those methods which remove the growth by the natural passages, the second those that require preliminary resection of parts in the way of the neoplasm by surgical methods. These latter operations belong to general surgery. The firm, broad attachment of the tumor to the base of the skull makes its removal by evulsion with strong postnasal forceps not impossible, but dangerous, as great force is required; and if the neoplasm have entered the bony structures towards the cranial cavity, penetration of the dura mater and meningitis may occur. The bleeding after evulsion is moderate.

The tumor can be removed piecemeal by Löwenberg's or other cutting forceps for postnasal operations, or it may be cut away with a curved blunt-pointed bistoury, a curved scissors, or a gouge. Any of these methods is applicable in some instances, but they are apt to be attended

by profuse hemorrhage, and if much force be used the resulting inflammation may prove fatal by extension to the brain. The growth may be torn away by the fingers when it is of the enucleable variety. This method is especially applicable to very large tumors. Two fingers are introduced into the nasopharynx and hooked over the tumor, while the index-finger of the other hand is passed through the nostril, which is generally widened by the dilating power of a nasal prolongation. Great force is required, and perforation of the cranial cavity may occur.

Ligature of the growth with the intention of having it subsequently come away by gangrene due to interrupted circulation has been abandoned as dangerous, on account of the great risk of resulting septic processes.

When the case is suitable for their employment snare operations are to be preferred to all others. When the tumor is pedunculated it may sometimes be secured in the loop of an *écraseur*, but more easily in a loop of steel wire with the ordinary snare; usually the tissue is so firm that it cannot be cut with the cold wire snare. The No. 5 piano-wire used for mucous polypi is liable to break, and wire of larger size cuts the tissue much less easily, so that it cannot be drawn through the pedicle except with a stronger and much more powerful instrument. The galvano-cautery snare (Fig. 125) is the best instrument for the removal of these tumors whenever they

are sufficiently pedunculated to allow of its employment. In performing the operation two soft catheters should be passed through the naris, endeavoring to carry one on each side of the growth and to bring them out of the mouth. Into the ends that are brought out of the mouth the ends of a piece of No. 20 platinum wire about three feet in length are introduced and pushed on until they come out of the nostril. A thread is attached to the wire loop to enable the operator to draw it backward in case of failure in the first attempt to place it about the tumor. The catheters with the wires protruding from the nostril are now drawn upon, and the loop, passing back into the mouth, is carried with the finger, or with the aid of a postnasal snare applicator (Fig. 169), up about the tumor, where it is drawn firmly into place. The catheters are then withdrawn and the wires intrusted to an assistant, who holds them carefully to prevent their becoming crossed in the naris. The ends of the wire are then slipped through the tubes of the galvano-cautery *écraseur* and fastened to the ratchet on the handle. It is desirable to have

FIG. 169.



Ingals's postnasal snare applicator (one-third natural size). For tumors in nasopharynx. The wire loop is held in notches at *D* by the slides *B*, *C*, which are held firmly by the cam *A*. As the loop is carried behind the palate the blades are opened so that the wire encloses the tumor; it is then tightened, the cam is loosened, the slides *B*, *C* are drawn slightly backward, and the wire is released and left in position while the applicator is withdrawn.

the distal ends of this electrode separated about a quarter of an inch, or even more, so that it may be the more readily passed upon either side of the tumor. As the instrument is pushed into the nose the ratchet is turned to tighten the loop, which is drawn tight upon the pedicle of the tumor before the electric current is turned on.

As it is very difficult to adjust the platinum loop properly with the patient under ether or chloroform, it is better to rely on the anæsthetic effect of cocaine; but its benumbing quality in this locality is not sufficient to prevent considerable pain during the burning off of the growth; therefore, when everything is in readiness, the patient should be told to bear the burning as long as possible, and that the current will be stopped as soon as he requests it. The current is then turned on and the ratchet tightened at the same time. The patient will endure the pain two or three seconds, then the circuit is broken and he is allowed to wait two or three minutes; as soon as he is again ready the circuit is again closed, and thus the process is continued until the pedicle is burned through. The tumor is then seized with a pair of postnasal forceps and withdrawn through the mouth. There is little or no hemorrhage from this operation.

The usual lightness of the tubes attached to the galvano-cautery handle for conveying the snare makes their extremities liable to spread, so that they at times permit a piece of the growth to enter between them. This piece will not be burned through, and therefore has to be torn away, with perhaps considerable bleeding as a result. It is, therefore, of advantage to unite the extremities of the tubes with a small piece of ivory drilled to receive them.

The current used should be just strong enough to make the wire cut readily. A white heat is apt to cause bleeding or to melt the wire, and this accident usually leads to severe hemorrhage. The melting may occur if a part of the wire be not firmly drawn against the growth, so that it gets hot in the air; therefore the loop should always be drawn tight before the current is turned on. When nasal prolongations are extensively adherent, or the sinuses are invaded by the growth, it may be impossible to apply the snare by way of the nares, and be necessary to slip it over the growth from the nasopharynx with the fingers. This is a very difficult manipulation, as the wire loop is apt to be bent out of shape. The snare tubes must have the proper nasopharyngeal curve. It is often impossible to apply the snare over the broadly attached and perhaps adherent tumor, and in this case the methods of operation described above must be resorted to.

Whenever, as the result of an operation, hemorrhage ensues, it may be necessary to plug the posterior nares. For this purpose the most satisfactory proceeding is that of passing through the naris a long strip of gauze, rendered styptic by saturation with tannic and gallic acids, as recommended in the treatment of epistaxis. The gauze is pushed back with the nasal probe or nasal scissors through the naris to the naso-

pharynx, and is there packed into the vault, with the finger carried up behind the palate. Finally, the naris itself is completely filled to prevent the plug from falling into the throat if it should become loosened. The tampon should be removed within from twelve to twenty-four hours by traction upon the end protruding from the nostril, by which the strip is gradually unfolded. In case clotting of blood has rendered the tampon hard and bound its folds together, it should be softened by gently injecting into the nostril a warm solution of sodium bicarbonate. Should recurrence of the tumor take place, it should be treated while yet small by the galvano-cautery or electrolysis, or by injections into the growth, by means of a long hypodermic needle, of a solution of from three to five per cent. of carbolic acid with from fifteen to thirty-five per cent. of lactic acid in water, the weaker solution being used at first and the strength gradually increased with subsequent injections. To prevent pain the injection should be preceded by a few drops of a four per cent. solution of cocaine. When retromaxillary fibroid tumors originating in the sphenomaxillary fossa become very large they must be removed from without by temporary resection of the zygomatic process, and at times of the coronoid process of the lower jaw; they belong, therefore, to general surgery, and cannot successfully be attacked from the nasal fossæ or nasopharynx. When the tumors are not more than one and a half inches in diameter they can be reduced by the lactic acid injections. Preliminary operations opening the way to the tumor are becoming less necessary as the methods for operating through the natural passages improve; but when the period of puberty is past, and the tumor recurs obstinately after operations from the nares or nasopharynx, preliminary operations may be needed in order radically to extirpate the growth. Examples of these are temporary resection of the upper jaw, or temporary separation of both upper jaws, or resection of the entire external nose. When the tumor reappears often after operation a strong suspicion of malignancy is justified. When it is suspected that the tumor has penetrated the cranial cavity, general surgical measures opening widely the way to the field of operation are to be preferred to operations by the natural passages, as sepsis and injury to the brain are less likely to occur. As a general rule, the methods of general surgery are to be tried only after operations through the nose or nasopharynx fail to relieve the patient.

Retronasal Fibromucous Tumors.—Retronasal fibromucous polypi are smooth, more or less ovoid tumors, varying from three-quarters of an inch to four inches in diameter. They cause obstruction of the posterior nares, especially in expiration, with consequent inability to blow the nose. They are less frequent than fibrous tumors.

Pathology.—These growths usually spring from the posterior border of the septum, or less often from the rim of the choanæ or under surface of the body of the sphenoid bone. Their origin, therefore, is close to the

posterior nares, and they resemble the nasal mucous polypi. Their histological structure is identical with that of the latter growths, the amount of fibrous tissue in their composition varying as it does in them. They generally, however, contain an excess of fibrous tissue, and are more dense than most mucous polypi. Those tumors growing from the posterior third of the nares are apt to be like the ordinary mucous polypus, while those originating back of this situation from the tissues near the posterior nares are generally more fibrous in character. The size of the tumors may be great enough to completely fill the nasopharynx.

Symptoms.—The symptoms are merely those of nasal obstruction which slowly increases, and, in fact, are identical with those created by nasal mucous polypi. Thus there are observed the dead voice, the mouth-breathing, and the other conditions described under these growths.

Diagnosis.—The tumors are readily diagnosed from retronasal fibrous tumors by their softness, great elasticity and mobility, lack of ten-

dency to bleed when touched or to cause frequent nose-bleed, the fact that they do not displace bony structures, and that they remain confined to the nasopharynx. Nasal mucous polypi can be diagnosed only by their seat of origin, as their structure is identical with that of the growths in question. Those containing more fibrous tissue and blood-vessels than usual are of darker color and firmer than the average mucous polypus. The differential diagnosis between nasal mucous polypi and retronasal fibromucous tumors is not of practical con-



FIG. 170.
Retronasal fibromucous tumor.

sequence. The latter are distinguished from malignant growths by the history, absence of pain and hemorrhage, smooth surface, and less degree of density.

Treatment.—These growths, if not too firm, can be removed with the steel-wire snare. When they are large and tough the hot snare may answer the purpose better. The bleeding during the operation and afterwards may be considerable, but can largely be controlled by the free use of adrenals. In most cases the wire loop can be passed over the tumor after the snare has been pushed through the naris, while the finger in the nasopharynx assists in adjusting the wire over the growth. If a loop cannot be slipped over the neoplasm, this can be torn away with postnasal cutting forceps of the Löwenberg type, as there need be no fear of so much hemorrhage as occurs in operating on nasopharyngeal fibrous tumors.

Retronasal Cartilaginous Tumors and other Rare Benign Growths.—The extreme rarity of these neoplasms makes it sufficient to merely mention them. Besides several cases of enchondroma, one of lipoma has been

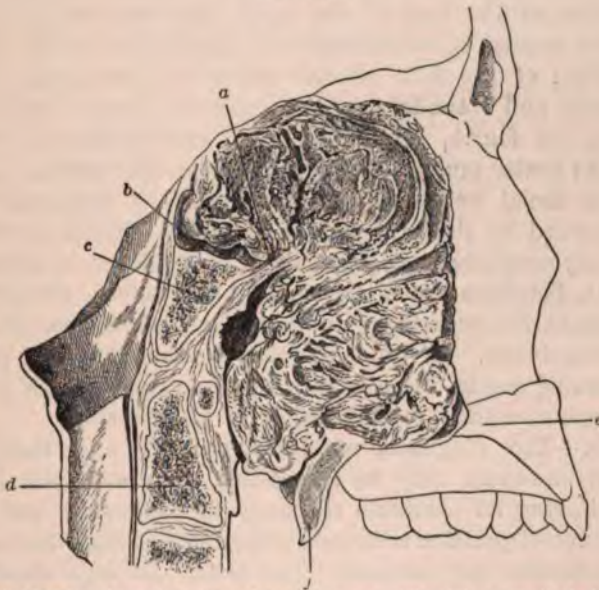
noted, also a few of papilloma. Cysts of the nasopharynx are found in the region of the bursa pharyngea, are of the retention variety, and have been considered under chronic rhinopharyngitis.

MALIGNANT TUMORS OF THE NASOPHARYNX.

Primary malignant growths of the nasopharynx are very rare. Secondary carcinoma is less infrequent, as epithelioma of the tonsil and soft palate often invades the postnasal space.

Pathology.—Both sarcoma and carcinoma are found in the nasopharynx. Sarcoma is of the spindle-celled or of the more malignant

FIG. 171.



Round-celled sarcoma of nasal cavity and nasopharynx. (Stoerk.) *a*, vault of pharynx; *b*, sphenoidal sinus; *c*, body of sphenoid bone; *d*, spinal column; *e*, hard palate pierced by tumor; *f*, uvula displaced forward.

round-celled type. A third variety of malignant growth very seldom found and mentioned among nasal malignant tumors is endothelioma. This has also at times, though very rarely, its seat in the nasopharynx. The commonest place of origin for all the types of malignant growths is the vault of the pharynx in the region of the pharyngeal tonsil. Occasionally they have grown from the posterior and lateral walls of the nasopharynx.

Carcinomata show their usual early tendency to ulceration as they advance and destroy the tissues in their path, so that tumor formation is less characteristic than disintegration. Sarcomata are less prone to ulcerate, but form large growths, which not only cause absorption of bony

substance or other tissues, as do fibromata, but substitute their neoplastic histological elements for the normal ones of the structures encountered. Thus the danger of invasion of the cranial cavity by malignant tumors is far greater than in simple fibromata.

Symptoms.—Sarcomata present symptoms like those of retranasal fibrous tumors, due to filling up of the postnasal space with the growth. The ulceration of carcinoma usually prevents its forming tumors of great size, but its destructive action is more marked. Endothelioma forms a large grayish-pink, friable tumor which is noticeable for its softness and rapid, exuberant growth. As is the case in fibrous tumors of the nasopharynx, the malignant growths are insidious in their course, and become noticeable only when they occlude the nasal passages, or when, by penetration of the base of the skull, they develop nervous symptoms. These consist of neuralgias and anæsthesias of the second and third divisions of the fifth cranial nerve as they pass through the foramen ovale and rotundum in the sphenoid bone. Paralysis of the optic nerve, the fourth, sixth, and third cranial nerves, with loss of motion of the ocular muscles supplied by them, also occur. Later in the affection the facial nerve may be involved. A paralysis of all the muscles supplied by the branches of the third cranial nerve, without accompanying exophthalmos, together with evidence of a tumor in the nasopharynx, betokens the malignancy of the latter. Carcinomata and often sarcomata disintegrate by sloughing and ulceration, often creating an intolerable stench. Severe hemorrhages accompany this process, and profuse bleeding marks the course of all these tumors. In youthful individuals some sarcomata consist mainly of blood-vessels.

Diagnosis.—The diagnosis of retromaxillary and nasopharyngeal fibroma from sarcoma may be impossible even with the microscope. Fibromata having an obstinate tendency to recurrence and showing a semi-malignant disposition to invade other cavities than the nasopharynx are often mistaken for sarcoma. The latter not only displaces bone, but enters into the structure of surrounding parts, so that it does not form so well-defined a tumor as fibroma. This characteristic may, however, be impossible to determine during life.

The great destructiveness, ulceration, and foul stench of carcinoma, together with the small tendency to tumor formation, severe neuralgic pains, and cachexia, should suffice to distinguish it from fibroma. The other innocent growths of the nasopharynx are mostly polypoid and pedunculated, and can hardly cause any difficulty in the diagnosis.

Prognosis.—Death occurs as the result of exhaustion, profuse hemorrhage, aspiration-pneumonia, or operations undertaken for the relief of the condition.

Treatment.—As soon as it is recognized that the nasopharyngeal tumor is malignant, treatment, if the growth be seen early, should consist in extirpation by the means suggested in the article on retranasal fibrous

tumors, and cauterization of its base with the galvano-cautery. Unfortunately, the tumors are almost invariably seen too late for more than palliative operations with the snare or other instruments. The more radical procedures by preliminary surgical operations giving access to the parts are to be undertaken only when the growth has made but little advance, otherwise they are useless.

In sarcoma the injection of the toxins of erysipelas and the bacillus prodigiosus should be attempted in the hope of causing absorption of the growth. Lactic acid in the strength mentioned under retronasal fibrous tumors and alcohol injections may also be tried with good result.

CHAPTER XVIII.

SYPHILIS AND TUBERCULOSIS OF THE NASOPHARYNX.

SYPHILIS OF THE NASOPHARYNX.

INFECTION from Eustachian catheters which have been contaminated by syphilitic poison has caused quite a large number of cases of hard chancre of the nasopharynx. This has made its appearance on the dorsum of the soft palate, the salpingopalatal fold, and in the neighborhood of the Eustachian opening ; in fact, in places which the catheter is likely to scratch during its introduction. The catheter may, however, not produce an initial lesion in the nasopharynx at all, but this may appear on the faucial tonsil. Primary syphilis of the nasopharynx is characterized by extensive induration, a tendency to destructive ulceration and inflammation of the surrounding tissues, while a large indolent, bubonic mass of lymphatic glands occupies the submaxillary region. The ulceration may cause perforation of the soft palate or periostitic processes.

Secondary syphilis may invade the nasopharynx, and is apt to lead to pronounced deafness of rather acute onset and frequently to otalgia. The deafness is due in some cases to syphilitic swelling of the pharyngeal tonsil. Superficial secondary ulceration (in rare cases deeper and more serious), papules, and condylomata may be seen on the dorsum of the velum, about the tubal orifices, and in the recessus pharyngeus. The pharyngeal tonsil may be swollen and present superficial ulcerations.

Tertiary syphilis of the nasopharynx seldom occurs before the second or third year after infection, and may be seen from twenty to fifty years after. Hereditary syphilis may not make its appearance until puberty or later, and may cause great damage to function by resulting cicatrices and perforations of the palate. Tertiary syphilis of the nasopharynx is usually associated with that of the nose or oropharynx, but may exist as an independent affection. It appears, as elsewhere, in the form of a gumma, arising in the submucous tissues as a formidable typical deep, clean-cut tertiary ulcer and as the brawny syphilitic infiltration of the mucosa of more superficial nature. This latter form is apt to lead to serpiginous, shallow ulceration. The deep ulceration is especially likely to attack the dorsum of the soft palate and destroy it extensively, so that when a small perforation appears on the oral surface the way is prepared for its rapid and extensive advance by the ulcer on the dorsum. In this manner in a short time the soft palate and part of the hard palate may be destroyed. Other tertiary ulcers involve the vault of the pharynx, the posterior wall of the rhinopharynx, the Eustachian

tubes, and the free border of the septum, resulting in necrosis of a part of the posterior portion of the vomer. The circumference of the choanæ, the posterior ends of the turbinals, and other structures may be attacked by ulceration. Tertiary syphilis, especially of the hereditary type, is responsible for a number of the cases of enlarged pharyngeal tonsil which come to the surgeon for operation. Besides necrosis of the posterior part of the vomer, the basilar process of the occipital bone, the posterior ends of the turbinated bones, and the anterior parts of the upper cervical vertebræ are liable to caries and necrosis. Tertiary nasal syphilis usually accompanies that of the nasopharynx, and the patient's complaints attract attention to the nose rather than to the parts back of it, as the stoppage of the nares and the foul nasal discharge are the most prominent symptoms.

The usual local symptoms caused by tertiary nasopharyngeal syphilis are obscure unless posterior rhinoscopy be employed. When oral, nasal, or pharyngeal syphilis, or the presence of the disease elsewhere, directs attention to its nature, syphilis of the nasopharynx may be suspected, otherwise the symptoms are apt to be attributed to catarrh or catarrhal deafness, while irremediable destruction is occurring in important parts. The chief symptoms are dysphagia, which may be severe, pain in the occipital and temporal regions and in the ears, tinnitus aurium, deafness, which may become absolute, dizziness, occluded nasal respiration, and collection of secretions in the nasopharynx.

Secondary syphilis usually leaves no trace of its presence in the nasopharynx after it has healed, though in rare cases it proves destructive. The consequences of primary syphilis in the nasopharynx have been considered. Tertiary syphilis is recognized early, and in its milder forms may do but little permanent damage, while in its grave variety it may cause serious lesions, great deformity, and even threaten life. Ulcerations of the borders of the choanæ are apt to lead to cicatricial stenosis of these passages, or in children to their complete atresia. In like manner cicatrices may cause partial or complete closure of the tubal orifices and resulting deafness. Loss of the soft and part of the hard palate may result from ulcerations working their way through these parts from the nasopharynx. Caries and necrosis of the anterior surfaces of the upper cervical vertebræ may lead to retropharyngeal abscess and even open the spinal canal, with resulting paralysis due to involvement of the spinal cord.

Diagnosis.—The secondary symptoms localized in the nasopharynx are associated with signs of the disease elsewhere, and therefore are not liable to be assigned to any other cause. The deafness may, however, be misleading when the possibility of syphilis is not kept in mind and its general symptoms are too slight to attract notice. The most serious mistakes occur when tertiary syphilis of the nasopharynx is overlooked because posterior rhinoscopy has not been performed. It seems incredible that it

should be omitted as often as it is in throat examinations. Tertiary syphilis of the nasopharynx may thus be supposed to be merely a chronic postnasal catarrh, with possibly accompanying deafness. Inspection of the parts will, of course, at once differentiate the two affections. Carcinoma does not have such clean-cut ulcerations as syphilis; the borders of carcinomatous ulcers merge insensibly into the surrounding hard infiltration of carcinoma, which is of a paler color and not so smooth as the gummy infiltration surrounding the tertiary syphilitic ulcer. In carcinoma the ulceration progresses much more slowly than does that of tertiary syphilis, while the characteristic pain and cachexia of carcinoma accompany it. In carcinoma there is enlargement of the lymphatic glands in the neck and under the jaw, while lymphatic-gland involvement is rare in syphilis in the tertiary period. Chancre of the nasopharynx is accompanied by a hard, dense, bubonic enlargement of the submaxillary lymphatic glands. There is a marked inflammatory halo about the chancre, and its borders are harder and more indurated than those of the gummatous ulcer.

Prognosis.—This is favorable when the disease is recognized early, but if extensive ulceration exist, even if this can be caused to heal, deforming scars are liable to result which may occlude the posterior nares, close the Eustachian tubes, or even cause the soft palate to unite with the posterior wall of the pharynx and partly or completely shut the nasopharynx off from the oropharynx. Necrosis of the base of the skull or of the vertebræ may lead to fatal complications of the spinal cord or brain. Extensive ulceration destroying the soft and hard palates may leave the oral and nasopharyngeal cavities united. Chancre of the nasopharynx usually lasts from six weeks to two months.

Treatment.—Considering its seat and the importance of the structures liable to injury, it is better to make an exception to the usual rule of waiting for secondary symptoms in the case of chancre of the nasopharynx and to begin constitutional treatment at once with the usual methods employed for secondary syphilis. Locally, insufflations of calomel, one-eighth of a grain three times a day, rubbed up with bismuth subnitrate or iodol, are useful, combined with irrigations of potassium permanganate, one-eighth of a grain to the ounce, applied with Freer's hard-rubber irrigating tube passed through the nares. Secondary syphilis of the nasopharynx requires no local treatment, but energetic constitutional measures. If the patient want something done locally, iodol insufflations can be used. Should the physician wish to avoid the danger of contagion, he can teach the patient to use the insufflations and irrigations himself. In tertiary syphilis of the nasopharynx, potassium or sodium iodide should be pushed to the physiological limit of tolerance. The ulcerations often refuse to heal until sequestra of dead bone from the vomer or base of the occipital bone or carious portions of other bone are removed. It may be necessary to curette the ulcerations with a sharp spoon. As a rule, however, constitutional treatment will speedily put a

stop to the disease. Locally, cleansing irrigations may be needed, and the ulcers will sometimes heal very promptly if touched daily for ten or twelve days with a strong tincture of iodine until the surface has a dry, glazed, brown aspect. If this treatment prove too irritating, swabbing with a sulphate of copper solution, from ten to twenty grains to the ounce, may be substituted for a few days.

TUBERCULOSIS OF THE NASOPHARYNX.

The nasopharynx, especially when deprived of its normal epithelium by frequent catarrhal states, is doubtless the place of entrance for the tubercle bacillus into the lymphatic system in some cases which develop tuberculosis of the lymphatic glands, and later pulmonary tuberculosis. While the lymphatic tissue of the nasopharynx gives ready passage to the tubercle bacillus, especially when it is diseased, as in hyperplasia due to catarrhal states, nevertheless, tuberculosis very seldom manifests itself in the nasopharynx, as the tissues of this region evidently form a poor soil for its localization.

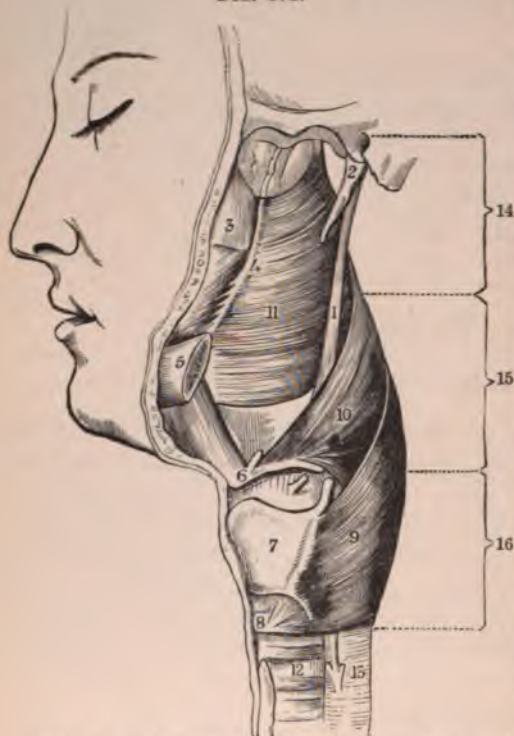
Etiology.—Tuberculosis of the nasopharynx is seldom primary, except in the case of tubercular tumors. The ulcerations are almost always secondary to advanced pulmonary consumption, and are caused by auto-infection of the nasopharynx with sputum. E. Fränkel, from examinations of phthisical cadavers, has proved that in the late stages of phthisis the tubercular ulcer of the nasopharynx is not especially rare, but is not discovered in moribund patients.

Pathology.—The disease manifests itself in the form of ulcerations, tubercular tumors, and tuberculosis of the adenoid vegetations. The latter condition has been considered under enlargement of the pharyngeal tonsil. Tubercular ulcers of the nasopharynx occur most frequently on the pharyngeal vault; next in frequency they attack the tubal prominences. They may also appear on the dorsum of the soft palate, the sides of the nasopharynx, or in the fossa of Rosenmüller. Ulcerations of the ends of the Eustachian tubes may result in their destruction. The character of the ulcers is that of tubercular ulcerations of the mucous membrane. The bottom is pale, often covered with purulent secretions, and apt to display sprouting, exuberant granulations. The ulcer has an ill-defined, irregular border, and is surrounded by miliary tubercles. The tissue in which the ulcer is seated is pale, and does not appear actively inflammatory. The losses of tissue are generally superficial, but in some cases the ulcers are deep and destructive, though not to the same extent as those of syphilis.

Tubercular tumors of the nasopharynx may occupy various situations in this cavity, such as the posterior part of the septum, the choanæ, and the back of the velum. They vary in size from a hazel-nut or smaller to tumors that fill the nasopharynx, and may be taken for malignant growths. They have a smooth, not ulcerated, surface, may be lobed, and are of a

geal and oral portions, and is situated behind the entire extent of the larynx. In its upper anterior wall lies the superior opening of the larynx. On each side of this is a longitudinal groove or fossa about one-half inch in its antero-posterior measurement and a little more in its transverse, called the "sinus pyriformis," representing the remains of the fourth original cleft. According to Quain, whose description is in

FIG. 172.



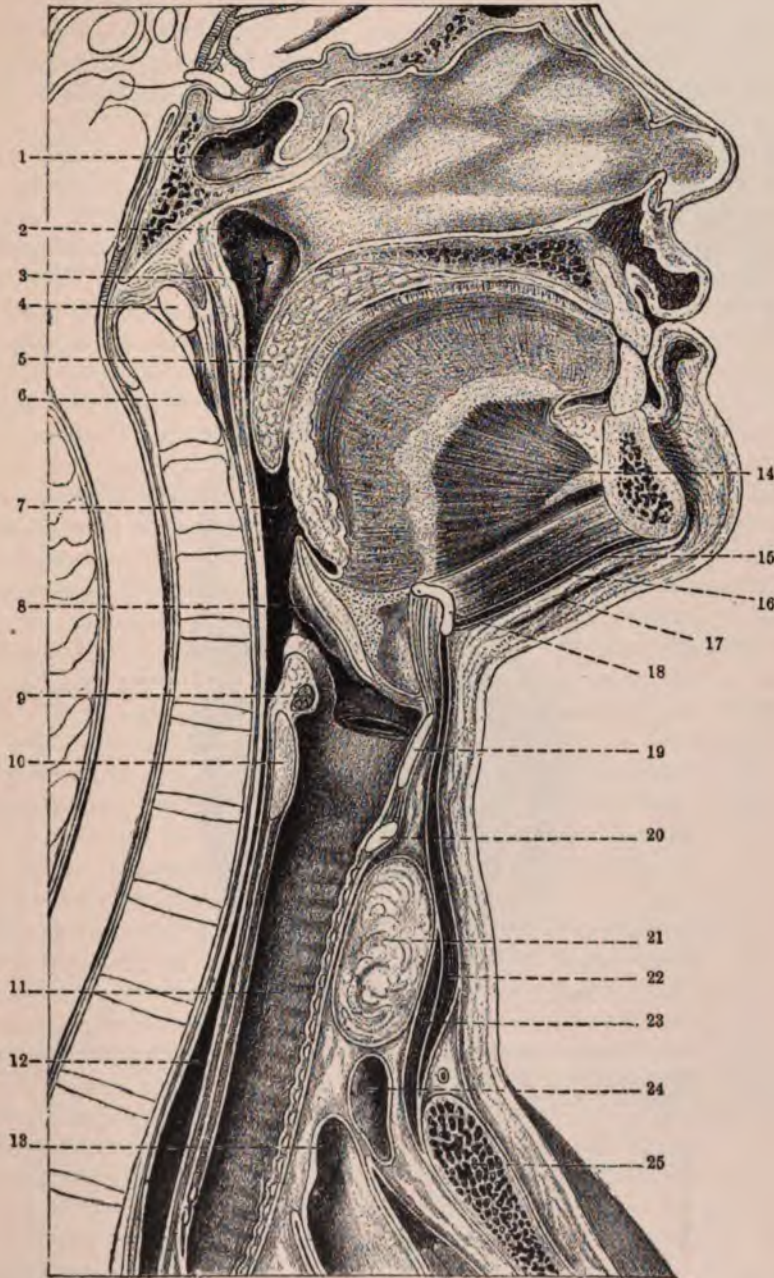
Side view of muscles of the pharynx. (Gray and Browne.) 1, stylopharyngeus; 2, styloid process; 3, upper jaw; 4, pterygomaxillary ligament; 5, lower jaw; 6, hyoid bone; 7, thyroid cartilage; 8, cricoid cartilage; 9, left inferior constrictor; 10, left middle constrictor; 11, left superior constrictor; 12, trachea; 13, œsophagus; 14, nasopharynx; 15, oropharynx; 16, laryngopharynx.

the main here followed, the transverse diameter of the pharynx opposite the laryngeal aperture is a little over three and a half centimetres. Below this level the anterior and posterior walls are in contact. The transverse diameter remains fairly constant until the level of the cricoid cartilage is reached, where it rapidly contracts, so that at its extremity it is only about fourteen millimetres. At about its middle is the level of the epiglottis, while anteriorly on either side is the upper portion of the glosso-epiglottic fold extending in a general forward and downward direction.

Passing from within outward, the walls of the pharynx are found to consist of four distinct layers. The mucosa is formed of connective tissue with low papillæ and covered with stratified epithelium, though the cells lining some of the gland-ducts show occasional cilia.

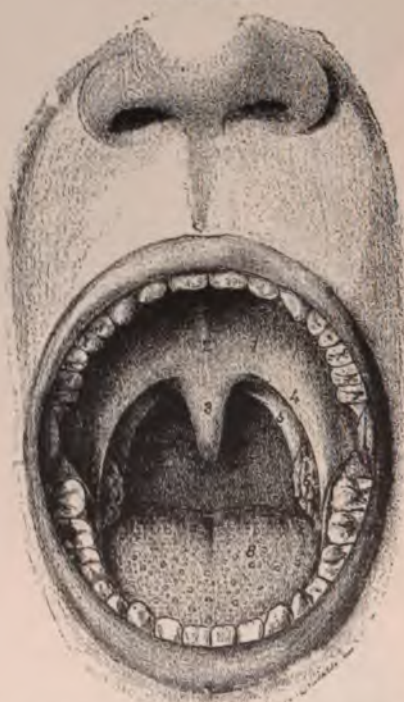
Racemose glands are numerous, while above lymphoid tissue is especially abundant. Next to the mucosa comes the pharyngeal aponeurosis, then the muscular coat, and finally another layer of fibrous tissue which unites with that covering the buccinator muscle, the combined structure being known as the buccopharyngeal fascia. The pharyngeal aponeurosis is thin and lax below. Posteriorly the buccopharyngeal fascia is connected by loose areolar tissue to the prevertebral fascia, covering the bony spine with its muscular attachments.

PLATE VIII.



Median section of the head and neck. (Quain, after Braune.) 1, sphenoidal sinus; 2, lateral recess of pharynx; 3, pharyngeal orifice of Eustachian tube; 4, anterior arch of atlas; 5, soft palate; 6, body of axis; 7, oral portion of pharynx; 8, epiglottis; 9, arytenoid muscle; 10, cricoid cartilage; 11, trachea; 12, oesophagus; 13, origin of innominate artery from aorta; 14, genioglossus muscle; 15, geniohyoid muscle; 16, mylohyoid muscle; 17, platysma; 18, hyoid bone; 19, thyroid cartilage; 20, cricoid cartilage; 21, isthmus of thyroid body; 22, sternohyoid; 23, sternothyroid; 24, left innominate vein; 25, manubrium sterni.

PLATE IX.



View of the soft palate and isthmus faucium from before. (Quain, after J. Symington.) 1, soft palate; 2, its raphe; 3, uvula; 4, anterior, and 5, posterior pillar of fauces; 6, tonsil; 7, posterior wall of pharynx; 8, dorsum of tongue.

The muscles of the pharynx are longitudinal and constricting. The former are the stylopharyngeus and palatopharyngeus on each side. Into the median pharyngeal raphe are also inserted the constrictor muscles, called respectively superior, middle, and inferior. The superior arises from the hamular process of the pterygoid plate of the sphenoid (*pterygopharyngeus*), from the mylohyoid line on the inferior maxilla (*mylopharyngeus*), from the side of the tongue (*glossopharyngeus*), and from the buccopharyngeal fascia (*buccopharyngeus*); the middle, from the greater cornu of the hyoid bone (*keratopharyngeus*) and from the lesser cornu (*chondropharyngeus*); the inferior, from the outer surface of the thyroid cartilage (*thyropharyngeus*) and from the cricoid cartilage (*cricopharyngeus*). All of the foregoing receive their nerve-supply from the glossopharyngeal trunk and from the pharyngeal plexus. Their lymphatic drainage passes eventually into the superior deep cervical glands. The blood-supply is very abundant, the vessels entering into it comprising the tonsillar and palatine branches from the facial artery, the descending palatine from the internal maxillary, ascending pharyngeal, and dorsalis linguæ.

Development of the Pharynx.—From a developmental point of view the pharynx is to be considered as the upper part of the alimentary canal. In mammals this extends from one end of the embryo to the other, below the vertebral axis presenting a manifest division into three parts. One of these occupying the embryonic part enclosed by the cephalic fold is named the foregut, being merely the upper part of the canal formed by the inflection of the hypoblastic layer of the original membrane, which supplies the epithelial lining of the principal cavities. The pharynx, then, is merely the enlarged cephalic portion of the foregut. The mouth proper is no part of the primitive alimentary canal, but is formed by an involution of parts of the face, and receives its lining membrane therefor from the epiblast. It is separated for a time from the pharynx by reflection of the blastodermic layers, but communication is finally established by a solution of continuity of these layers. This septum between the foregut and stomodæum, as the mouth involution is called, is manifest in the human embryo as early as the twelfth day, and the disappearance of the septum occurs soon after.

Anatomy of the Soft Palate.—The soft palate is the musculo-aponeurotic curtain which projects downward and backward into the pharynx from the posterior border of the hard palate,—that is, the posterior edge of the horizontal portions of the palate bones. It is covered with mucous membrane continuous with that of the surrounding parts. From its middle hangs a fleshy projection, the uvula, which is composed mainly of the azygos uvulæ muscle, formed by the union of two symmetrical strips or bundles of fibres which arise, one on each side of the median line, from the tendinous structures of the soft, and occasionally the middle of the posterior border of the hard, palate. The sides of the base of the soft palate gradually extend down into the two pairs of muscles known as the

faucial pillars, to which reference has already been made. In the soft palate also terminate two other symmetrical muscular bundles on each side. These are made up of the levator palati, arising from the petrous portion of the temporal bone in front of the orifice of the carotid canal, and from the cartilaginous portion of the Eustachian canal, passing downward and forward and inserted into the posterior surface of the soft palate, and the circumflexus or tensor palati, arising from the navicular fossa at the foot of the internal pterygoid plate, from the outer surface of the Eustachian canal, from the spine of the sphenoid and the edge of the tympanic plate of the temporal bone, passing downward on the internal pterygoid plate between it and the muscle of the same name. It ends in a tendon, which passes around the hamular process, where a synovial bursa smooths its passage horizontally inward, and terminates in the fore part of the aponeurosis of the soft palate and the under surface of the palate bone.

The innervation of the palatal muscles is undoubtedly from the vagospinal nerve, though this view is opposed to the older teaching. Turner¹ believes that the nuclei of origin of both the bulbar nerves—glossopharyngeus and vagus—are really parts of one mixed nerve, having a dendrite nucleus of origin of their efferent (motor) fibres. This is called the nucleus ambiguus. From its lower end the lowermost of the vagal root-fibres emerge, and passing into the trunk of the vagus nerve are given off by the pharyngeal branches to the pharyngeal plexus, from which they are distributed to the levator muscles of the palate.

Physiology of the Pharynx and Soft Palate.—Leaving out the nasopharynx, it may be said that while the rest of the cavity is a common way for both air and food, it properly belongs to the digestive rather than the respiratory tract. During deglutition the larynx is drawn upward and forward by the muscles attached to the hyoid bone and by the stylopharyngeus so as to be both closed by the epiglottis and overlapped by the tongue. At the same time the palatoglossus muscles constrict the fauces, and so shut off the bolus from the mouth. The forward and upward movement of the larynx is of more importance than the “coverlid” action of the epiglottis, for the removal of the latter from animals does not prevent them from swallowing without difficulty. A like favorable result remains after the destruction of the cartilage by various ulcerative processes. An additional safeguard against the entrance of food into the air-tube is found in the sphincter-like action of the muscles which surround the top of the larynx. The voluntary part of the process now ceases and the involuntary begins. The soft palate being made tense by the action of its superior muscles, the palatopharyngei are approximated, the uvula being between, and thus prevent the ascent of the bolus into the nasopharynx. They also bring the posterior wall of the

¹ Laryngoscope, 1898, vol. v. p. 33.

pharynx somewhat forward, and in this manner guide the bolus into the lower pharynx. It now meets the action of the constrictors, which by their vermicular movement from above downward guide it into the œsophagus.

It is thus seen that the action of swallowing is a complex one, and if there is any interference with the harmonious action of the various muscular structures there is a liability of the passage of ingesta into the nasopharynx (*e.g.*, diphtheritic paralysis) or into the larynx (*e.g.*, bulbar paralysis).

The faucial structures are also concerned in articulation. The lungs, acting as a bellows, force air against the vocal bands, setting up vibrations which produce the "raw material," so to speak, of articulate speech, while its modification into letters and syllables is effected by the varying movements of the soft structures higher up. The soft palate hanging as a curtain can divert the sound-waves either into the nasopharynx or the mouth, thus producing either nasal or oral tones. Pure vowel sounds are conditioned upon the raising of the curtain, while consonants require the interruption of the sound-waves by the parts anterior,—*e.g.*, tongue, teeth, and lips; hence the division of consonants into gutturals, dentals, and labials. The proper action of the soft palate also has reference to the production of overtones in singing.

Marian¹ has recently maintained that the soft palate appreciates the gustatory sensations of sweet and bitter, as tested by solutions of sugar and quinine. This is due to the ramifications of fibrils of the glosso-pharyngeal nerve on its anterior surface.

Various functions have been assigned to the uvula. It has been looked on as a conductor of the secretions of the parts above and behind to the mouth. Some have regarded it as analogous to the weight on a drop-curtain, preventing too long contact of the moist soft palate with the posterior wall of the pharynx. Still another view assigns to the organ the rôle of a pillar to support the soft palate during phonation, the base being the tongue.

METHODS OF EXAMINATION.

For the proper inspection of the fauces and pharynx the patient, if able to be out of bed, should sit in a straight-backed chair with the shoulders slightly backward but the chin a little depressed. For examination by direct light the examiner stands a little to one side so as not to obstruct the rays from the source of illumination. A few patients can depress the tongue sufficiently to allow of a fairly good inspection of the oropharynx, but the help of some form of tongue-depressor is generally needed, familiar varieties of which are herewith figured.

Tongue-Depressors.—The use of a particular instrument is somewhat a

¹ L'Écho Méd. du Nord, January 28, 1900.

matter of habit. The Türk variety with the curve at the bottom of the handle can be held by the patient himself if for any reason the examiner requires the use of both hands. The patient having fully opened the mouth, the examiner presses the blade firmly though gently down on the dorsum of the tongue, care being taken to avoid either pressure or traction on its root, both of which invite gagging.

As to the source of illumination, sunlight is preferable if it can be had, because it best shows the normal color of the parts. If the patient is in bed any kind of a lamp can be used, or the simple device of a candle backed by the bowl of a large spoon, which makes an excellent reflector. The matter of source of light is further considered under "Examination of the Larynx," where the indirect method of examination by means of the head-mirror is explained.

FIG. 173.

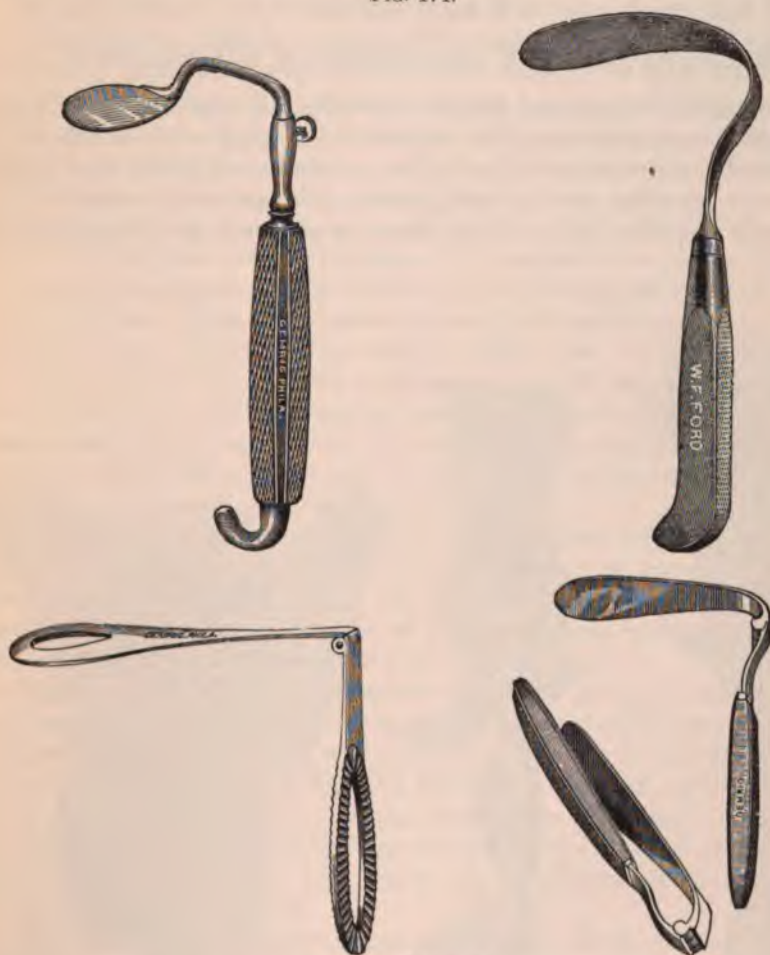


Method of depressing the tongue for examining the pharynx and for posterior rhinoscopy. (Bosworth.)

The pharynx having been thus exposed to view, the physician should look for possible vascular changes, swellings, ulcerations, or deposits on the various regions of the throat. The gums should be examined for the characteristic changes of mineral poisons, inflammations, ulcerations of the various dyscrasias, and for indications of depraved blood states (scurvy, anæmia, etc.). The uvula and soft palate should be touched with the probe (a simple but much-neglected instrument) to determine their sensitiveness and motility. According to Lennox Browne, congestion of the anterior pillars betokens associated digestive disorders or some dyscrasia, while that of the posterior pillars suggests improper or excessive vocal effort.

Certain conditions affecting the tongue concern the laryngologist, especially the state of the vascular and lymphoid structures at its base. So also the condition of the same structures on the posterior pharyngeal wall

FIG. 174.



Tongue-depressors.

should be carefully observed. The conditions to be noted concerning the faucial tonsils are spoken of under diseases of those organs.

To overcome irritability ice-water gargles, weak cocaine solutions, etc., may be used, or, in the more obstinate cases, the system should be brought under the influence of the bromides.

CHAPTER II.

MALFORMATIONS AND DEFORMITIES OF THE PHARYNX.

THE various deformities which result from the different specific processes are considered under the respective headings of those affections. Congenital malformations occur either as stenoses or pocket-like dilations, and are often due to unexplained developmental errors. They commonly occur low down in the pharynx proper or at the junction of

FIG. 175.



Congenital pouch and atresia of the pharynx.
(Lennox Browne.)

FIG. 176.



Pouch of the pharynx in advanced life.
(Lennox Browne.)



the oro- with the nasopharynx. Unless some intercurrent inflammation takes place, the patient rarely experiences any inconvenience. At the lower site there is sometimes a narrow, annular, perforated septum just at the œsophageal junction, with a superjacent stenosis.

Traumatic stenosis may follow the ingestion of some corrosive poison, scalding water or other fluids (common with children). Stenosis may also result from pressure from a retropharyngeal abscess, glandular enlargements, or spinal disease.

PHARYNGOCELE.—A special deformity from dilatation is that known as pharyngocele. This is a peculiar diverticulum, due either to pressure or traction, though the action of the latter force in the case of the pharynx has been denied. The pocket is always found at the lower portion of the pharynx or at the upper portion of the œsophagus, and is sometimes lateral, sometimes median. At this site the muscular layer is thin and the fibres run in parallel lines. The larger diverticula hang down as pouches between the spine and the gullet. The walls are thick and firm, and are formed by the bulging of the mucosa between the fibres of the musculosa. A sort of adventitious sphincter is found around the neck of the sac. Most of the cases are among adolescents, and women are rarely, if ever, affected. The cause is often hard to ascertain. The sequence of events seems to be as follows: a part of the pharyngeal wall loses its power of resistance against pressure; this may result from some foreign body remaining in and separating the muscular fibres, as a crust of bread, cherry-stone, bone, etc., or there may be a rupture of the muscular fibres from violence or excessive vocal effort.

Given from any cause a spot of least resistance, the rest of the pharynx acts most forcibly against it. The mucosa bulges, the musculosa yields, and thus a sac is formed; ingesta fall into the latter, and, from a lack of correspondence between the axes of the œsophagus and the pharynx, very little food enters the latter cavity.

Symptoms.—Inability of the food to reach the stomach soon leads to emaciation, but before this stage is reached it will be easy to recognize a cervical swelling on one or both sides, from which food can be forced out by pressure. A sound passed into the pharynx is arrested by the pocket, and it is extremely difficult to make it enter the œsophagus. Pressure on surrounding structures may cause various disturbances of the circulatory and vascular systems. Later there may be adhesive inflammation of the sac to surrounding parts.

Treatment.—In the earlier stages the patient should be fed on fluid diet and through a tube. Electricity may be used to strengthen, if possible, the muscular coat. Surgical treatment consists in performing pharyngotomy and removing the sac from without, and modern surgery has recorded many triumphs in this field. The honor of the first successful case belongs, I believe, to W. I. Wheeler.¹

DEFECTS IN THE FAUCIAL PILLARS.—Several cases of this nature have come under the observation of the writer.² They are not as un-

¹ Dublin Jour. Med. Sci., 1886, p. 460.

² Anatomical Defects in the Fauical Pillars, Laryngoscope, 1897, vol. ii. p. 220.

common as is generally supposed, yet, according to Fineke,¹ Rosenberg found only twenty-five instances out of fifteen thousand patients examined, while Fineke himself found only one instance in four thousand patients. The anterior pillars are involved in eighty per cent. of the cases, and sixty per cent. occur on the right side. Occasionally there is a double defect in the same pillar. The gaps are generally oval in shape, measuring on the average three by ten millimetres in diameter, the long axis of the oval corresponding to that of the pillar. The edges are perfectly smooth and the surrounding mucosa is normal.

FIG. 177.



Separate mucous investment of the palatoglossus muscle on each side. (Bosworth.)

Cases of this nature fall into two categories: first, congenital cases, and, second, those due to some destructive process. The latter may result from the breaking down of gummy deposits, or from an opening left after incising a phlegmon in this region. The congenital cases are now looked upon as incomplete closures of the original branchial clefts. Other theories are those of Testut, who believes that they are due to embryonic absorption of tissue previously formed, and of Broeckaert,² who regards them as analogous to the partial persistence of the pharyngeal clefts sometimes found in the form of fistulæ more or less complete and situated towards the bottom of the lateral pharyngeal walls.

The first case, reported by Wolters in 1859,³ was that of an adult male. Both anterior pillars presented an hiatus. The literature of the subject is then a blank until 1878, when a second case of symmetrical defects in the anterior pillars was reported by J. Solis Cohen,⁴ the patient being a man aged forty years. Cohen suggested that the condition was essentially a separate investment by the pharyngeal mucosa of the palatoglossus muscles, though he offered no suggestion as to the cause of the defect. He adds that caution should be exercised not to confound such absence of tissue with the results of previous ulceration (Fig. 177).

¹ Archiv. Internat. de Laryngol., 1899, vol. xii. p. 233.

² Rev. de Laryngol., 1893, vol. xiv. p. 577.

³ Zeitsch. f. rationale Med., 1859, Bd. vii. S. 156.

⁴ New York Med. Record, 1878, vol. xiv. p. 44.

In reporting six cases, Boucheron¹ gives no particulars, except to say that lymphoid hypertrophy in the pharyngeal vault was found in all. In one case Schrapinger² noted a furrow on the upper lip running down from the nostril towards, but not quite reaching, the mucocutaneous junction. He suggests that there may have existed an intrauterine hare-lip, cured before birth.

A point of considerable interest is the rudimentary condition of the tonsils frequently found in these cases. Fowler³ believes this to be the rule. In one of his cases with almost complete absence of the faucial tonsils there was a broad band of lymphoid tissue, suggesting, he says, compensatory hypertrophy, extending across the tongue, apparently (from his description) anterior to the lingual tonsil. It has been pointed out, however, that rudimentary tonsils are frequently found in persons with normal pillars. In one instance Claiborne⁴ found a supernumerary tonsil.

All of these cases are, in the main, free from any symptoms; where the tonsils have been wanting there has sometimes been a pocketing of soft foods between the pillars. Most of the cases have come to light during routine examinations of patients who were in no wise suffering from any symptoms referable to the fauces.

¹ *Rev. de Laryngol.*, 1890, vol. x. p. 528.

² *Monatssch. f. Ohrenh.*, 1884, Bd. xviii. S. 204.

³ *London Lancet*, 1892, vol. ii. p. 1493.

⁴ *New York Med. Jour.*, 1890, vol. li. p. 147.

CHAPTER III.

ACUTE INFLAMMATIONS OF THE PHARYNX.

AN explanation of the etiology of the acute affections of the pharynx is found in its double function as food-tube and air-conduit. It therefore shares in the affections of both the digestive and the respiratory tracts. Scrofula, gout, and rheumatism underlie many acute outbreaks. Being a combination of fibrous aponeurosis, muscle, and mucous membrane, it naturally shares in the forms of inflammation which affect these structures throughout the body.

ACUTE CATARRHAL PHARYNGITIS.—This is an example of the simplest type of an acute inflammation in a mucous membrane,—the exudative.

Etiology.—No age is exempt. Spring and fall (damp days) furnish the greater number of cases. Sudden changes of temperature are a prolific exciting cause. General predisposing causes include bad general environment, poor ventilation, unsuitable clothing, inhalation of noxious fumes, and certain occupations attended with much dust or requiring labor in high temperatures.

The pharynx is practically an immense culture-tube for all sorts of bacterial growth. Miller¹ has shown that it is the habitat of more than one hundred different species of various lower organisms. Under normal circumstances they are all harmless. The "catching cold" which is so often given as the cause of acute catarrhal attacks really means lessened resistance of the tissues to germ vitality, and is synchronous with increased germ virulence; it sounds the note of bacterial attack upon the mucous membranes. Many cases of acute pharyngitis are referable to ingestion of irritant food, alcoholic excess, overuse of tobacco, foreign bodies, etc. A disordered stomach and that group of symptoms known as a "bilious" attack are at the bottom of many cases of this nature. The bearing of this fact on the initial therapy is obvious.

Pathology.—The disease is a simple acute exudative inflammation with its sequences of congestion, swelling, dryness, and later increased secretion with the customary escape of leucocytes, and in the more severe cases the rupture of superficial capillaries and the escape of a little blood. The inflammation may be diffused or confined to various sites, such as the posterior wall of the pharynx, fauces, or palatal folds. For the latter localization the term "faucitis" is sometimes used. The covering of the tonsils is generally affected also. The pharyngeal mucosa may be

¹ Micro-organisms of the Human Mouth, Philadelphia, 1890.

simply reddened, or where there is an acute exacerbation of a chronic process it may be, in addition, shiny, smooth, or granular.

Symptoms.—Initial symptoms may be either local or general. As a rule, there is a mild constitutional febrile reaction. Locally there is a sensation varying from a mere dryness to a pain of considerable intensity. This pain is experienced not alone in inflammations of the pharynx but also in those of adjacent areas, notably the nasopharynx and even the nose, though it is invariably referred by the patients to the pharynx. Swallowing is painful, there is an irritative cough with the constant sensation as of a foreign body, and thick viscid mucus, sometimes streaked with blood, is expelled.

Prognosis.—This is always good as regards the eventual integrity of the tissues, for the disease rarely extends to the deeper structures.

Treatment.—A mercurial should be administered, followed in a few hours by a saline, and later by small and alternating doses of belladonna and aconite or veratrum. Ice-pellets give much relief to the pain, and cold applications may be made to the neck. Weak cocaine solutions are also admissible, provided they are used with a graduated atomizer and the quantity of the drug employed does not exceed the limits of a safe internal dose; but menthol in albolene, fifteen grains to the ounce, is often just as serviceable. During the stage of increased secretion any astringent troche may be used. If the stage of dryness is unusually prolonged, tartar emetic, apomorphine, and remedies of that class may be given with a view to re-establish the secretion.

In diathetic cases the salicylates, guaiac, colchicum, and the combinations of iodine with iron find their peculiar field of employment, and in all cases a simple tonic is advisable after the subsidence of the acute symptoms. Most cases, however, are in the second stage when they come under the observation of the physician, particularly those of a milder type, not confining the patient to bed. When the inflammation is confined to that part of the pharynx which comes under immediate inspection it is possible to remove the inspissated secretion with some warm alkaline spray, as Dobell's solution or that made from the Seiler tablet, after which astringent solutions should be applied directly to the parts. This application may be made by spray, brush, troche, or gargle. Nothing is gained by the employment of an elaborate formulary of the new and more fashionable remedies; the faithful use of those that are old and tried will give as prompt and satisfactory results. Tannin ten grains, with five of alum, to the ounce of water may suffice. The writer prefers the glycerite of boroglycerin in these cases, using it in full strength on an applicator, or, if the mucosa is especially tender, diluting it with a little water. Doubtless the good effects of many solutions are due to their antiseptic properties, even though the latter are weak.

It has become the fashion in certain quarters to decry the use of gargles. Certainly troches are very much more easily handled, but the writer

does not believe that the day of gargles has entirely gone by. It is alleged that they put a strain on inflamed structures, and that the fluid comes in contact with only a small portion of the inflamed area, never passing beyond the anterior faucial pillars. Every sore throat does not require a gargle, but there are many that do. Saenger's contention that but very few persons are able to cleanse the parts back of the anterior pillars cannot be accepted. The writer believes that the tonsils can be reached by gargling, except at the extreme upper portion; some parts of the lateral pharyngeal walls can be reached only with the applicator. It is true that some patients experience great difficulty in gargling, but in them a spray coarse enough to be of any service is apt to cause gagging.

During the attack the food should be bland and unirritating. Special attention should be paid to footwear and underclothing in order to prevent recurring attacks. The neck and upper chest should be douched night and morning with cold water and briskly rubbed with a coarse towel. If this latter is done with the body clothed to the waist and with the stockings on, there is but little danger of the occurrence of the unpleasant sensations which come from deficient reactive power.

ACUTE PHLEGMONOUS PHARYNGITIS.—In certain cases the inflammation extends from the mucous membrane into the submucous tissue, and is then called phlegmonous pharyngitis. This extension may be caused by thermal and mechanical influences, operations, and galvanocautistic manipulations. Secondarily it forms a possible feature of various acute infections, notably scarlet fever. Some persons are especially liable to this variety of pharyngitis, a predisposing cause existing in their lowered vitality. Generally the attack extends to the soft palate and associated tissues. This form is considered under its appropriate heading.

A rare form of phlegmon in this locality is that known as acute infectious phlegmon of the pharynx. This disease was first described by Senator in 1888. Bosworth (edition of 1892) was able to find records of but eleven undoubted cases, so that the lesion must be looked on as one of the rare lesions of the pharynx. Dudefoy¹ added a few additional cases to the list already published. Still more recently a case has been recorded by von Stein, in which death occurred from meningitis and abscess in the left temporal lobe, being the first fatality from this particular complication. Nothing is yet positively known as to the exact nature of the latter. The disease may be an atypical form of erysipelas.

Pathology.—The disease is an acute inflammation, generally in the oropharynx, which rapidly assumes an infiltrating purulent character involving the deeper layers of the mucosa. Bosworth states that the inflammatory infiltrate always remains as such, and never passes to abscess formation, at least in the tissue originally affected. Progress is generally in a downward direction. Extension to the air-tract is characterized by

¹ Thèse de Paris, 1894.

œdema at all sites where the tissues are of loose formation. The type of inflammation is distinctly a septic one. Glands are involved, and the cervical tissues may become so filled up that the hollow between the neck and shoulders is quite obliterated. Later any part of the body may become the seat of pyæmic metastasis.

Symptoms.—The disease generally begins with sharp pain in the pharynx, marked dyspnœa, and intense pain in swallowing, all due to the œdematous condition of the structures involved. Pressure over the thyroid body causes pain, and this sign is of some diagnostic value. From the outset there is presented the clinical picture of profound infection, with fever, delirium, and albuminuria. Of the nineteen cases collected by Dudgeon, only five recovered. Death followed by inhibitory cardiac paralysis even after the air-channel had been opened by tracheotomy.

Treatment.—There is no specific treatment. Anti-streptococcus serum may be used, but its employment has not yet been sufficiently extensive to allow any definite results to be predicated. The main initial indication is to counteract the sepsis by free stimulation, quinine, strychnine, control of temperature, and a supporting diet. The diffuse infiltration renders surgical intervention somewhat indefinite, though there should be no delay in performing tracheotomy if the air-passages become obstructed.

MEMBRANOUS PHARYNGITIS.—In many cases there is doubtless a membranous deposit on the pharyngeal walls. Clinically, most cases are really true or false diphtheria, or else the disease assumes a subacute or intermittent if not actually a chronic character. More will be said on this topic under the heading of chronic pharyngitis. Undoubtedly various bacterial forms are capable of causing an exudate. Glasgow¹ has reported a case which he considers one of the protean forms of influenza. His patient was a child aged ten years, who after unusual exposure to cold was attacked by fever and earache of two days' duration, followed by a coryza with a copious discharge of acrid mucus which excoriated the skin of the lip. Then came an exudation on the soft palate, tonsils, pharynx, and uvula. It was persistently white, much elevated, easily detached, and left no ulcer except on the palate. The skin lesions caused by the mucus were very similar to those on the mucosa; they had, however, raised edges, and the exudate appeared on an excoriated base. There was no glandular enlargement, nor was the mucosa of the bronchi or of the bowels involved. Aphonia and urgent dyspnœa were present, due probably to an involvement of the larynx. Brandy was given internally with salol and sodium benzoate. Locally, hydrogen peroxide was used, followed by boroglyceride applications. Convalescence was rapid, though interrupted by a suppurative otitis.

¹ Trans. Amer. Laryngol. Assoc., 1894, p. 124.

SUBACUTE PHARYNGITIS.—This form of pharyngitis is a clinical rather than a pathological variety. Many patients are just on the verge of an acute attack. Their voices are husky, they suffer more or less from a constant tickling cough, and the muscles of deglutition are hypersensitive, as shown by a frequent desire to swallow. Actual pain is rare. As Browne has observed, this symptom varies with the temperament of the individual.

The throat generally shows a patchy redness and an irregular thickening and swelling of the tissues with more or less of a viscid yellowish secretion. Treatment should be commenced with thorough purgation, followed by astringent lozenges or gargles, the latter being especially indicated if the soft palate is notably affected. These patients should be cautioned as to their diet; care in this respect will generally keep them comfortable. Tobacco, alcohol, and all rich foods should be prohibited.

CHAPTER IV.

CHRONIC INFLAMMATIONS OF THE PHARYNX.

UNDER this heading may be considered inflammation of the pharyngeal lining as a whole and that subdivision of the process affecting especially the lymphoid elements and known as follicular pharyngitis. A localized form of the latter is known as pharyngitis lateralis.

In simple chronic catarrhal pharyngitis the inflammation is, as a rule, confined to the pharyngeal mucosa. The uvula, palate, and faucial pillars usually escape, though there are cases in which the inflammation seems to localize itself in the faucial pillars, these cases being denominated chronic faucitis. In patients below middle life enlargement of the tonsils is occasionally met with.

Etiology.—A frequent cause is the continued inhalation of irritants. As to the direct effect of tobacco in this class of cases, some authorities state that the nicotine and other volatile products set free in smoking will set up a chronic pharyngitis from the start, while others maintain that these agents merely aggravate pre-existing conditions. The cases are apt to be associated with chronic nasopharyngitis, and it may be that the constant hawking involved in cleansing the nasopharynx so strains the pharyngeal muscles as to aggravate any pre-existing catarrh. Also, an abnormal state of the nasal chambers predisposes to this condition.

Pathology.—The change may be described as a proliferative inflammation occurring in a mucous membrane. The blood-vessels do not take any active share in the process except presenting in the earlier stages a slight hyperæmia. The principal change is the formation of a low grade of connective tissue in the deeper layers of the mucosa. In this situation the mucous glands are scanty, and those present do not show much change. The secretion is apparently increased in amount and is more or less viscid. The latter characteristic is not so much an evidence of secretion perverted in initial quality as it is that the conditions surrounding the pharynx are abnormal, especially with reference to the quality of the air passing over it. In some of the long-continued cases enlarged veins with nodosities course over the surface.

Symptoms.—The close relationship of the affection to gastric disorders often makes the special symptoms of the latter the most annoying feature. These consist of morning retching, nausea, and occasional vomiting, together with a continual irritation in the pharynx, which is increased by swallowing highly seasoned foods and hot drinks. Actual odynphagia is rare. The whole lining of the pharynx is extremely sensitive, and it is

often impossible to make any satisfactory examination at the first sitting. The mucosa is of a dark red and beefy color, which, however, as a rule, does not extend beyond the posterior pillars. The breath is sour and offensive and the tongue more or less coated. The grade of severity of symptoms is often conditioned by the amount of accompanying nasopharyngitis. If the latter is considerable, the peculiar color of the mucosa is not limited by the posterior pillars, but is more or less diffused over the soft palate. Occasionally a superficial vessel may rupture and slight bleeding occur.

Treatment.—This should be first directed towards the correction of any vicious habits in eating and drinking, while the pharynx may for a while be best let alone. Weak cocaine solutions may be used to facilitate examination, but, if used in spray, the amount of the drug must not exceed that of a safe internal dose, for some is bound to be swallowed. In some cases it is necessary to put the patients on an ice-water gargle or one of the bromides, the latter being swallowed after being gargled, so as to reduce the general reflex irritability. During treatment, tobacco, alcohol, coffee, and tea should be cut off; particularly does this latter apply to institution patients, whose tea is almost always a strong tannic brine. Salines and cholagogues, alkalies with bitters, find here appropriate employment. Greasy foods and pastries fall under the ban. Directions should be given to insure proper mastication of food; hence little fluid should be taken at meals.

Many cases will be greatly relieved if not entirely cured under such a plan. Should the symptoms persist after the stomach is regulated, the nose must be looked after and existing abnormalities removed. For direct application to the pharynx, solutions of silver nitrate not exceeding twenty grains to the ounce, or the zinc salts in the same strength (excepting the chloride), may be used on a cotton carrier, though alum-nol in a little stronger solution is preferred by many. The writer has employed with satisfaction, as a menstruum for the ordinary list of topical agents, zinc oleostearate, which is a combination of zinc stearate with benzoinated albolene. It is a viscid, whitish mixture of rather agreeable taste, and insures as long a contact of the medicament with the tissues as is possible under the circumstances.

CHRONIC MEMBRANOUS PHARYNGITIS.—Cases are seen from time to time which present recurring membranous deposits in the pharynx and fauces. It may not be quite correct to call them chronic cases, but the symptoms never assume the type of acute inflammations. In this category falls the group of cases which have been reported as due to the bacillus of Friedländer. This germ has been found in antral pus, suppurative rhinitis, ozæna, rhinoscleroma, and various other conditions. In all cases the distress is very slight, often bearing no relation to the extent of the membranous deposit, which is apt to be persistent. Glandular swelling and fever are absent. The membrane is of a pearly white

color, very adherent, and on detachment leaves a bleeding surface. The mild type of symptoms makes the cases of clinical rather than of pathological importance, if the danger of their presence in other conditions be excepted. The cases evidently get better by limitation, as no therapeutic measure has proved of any avail.

CHRONIC FOLLICULAR PHARYNGITIS.—This form of disease is practically confined to the mucosa of the pharynx proper and does not affect the faucial structures. As its name signifies, the brunt of the pathological change falls upon the lymphoid structures which are found in the deeper layers of the mucous lining. The clinical importance of the condition lies in the fact that the symptoms are comparatively severe in view of the mild appearance of the lesion, this severity depending on the involvement, in some way not yet clearly understood, of the sensory nerve-fibrils supplying the affected area.

Etiology.—The causes of this form of pharyngitis include the action of that diathesis which is called lymphatism, or the tendency of all the lymphatic structures to take on an overgrowth at an early period of life. This condition corresponds to the "scrofula" of the early writers. While hardly admitting the identity of the two, there is no disposition to deny their relationship. The lymphatic overgrowth begins in early childhood, affecting to a varying degree all the lymphatic structures in the region of the pharynx and nasopharynx; but in the earlier years the symptoms referable to the latter area predominate, while those attributable to the follicular change in the pharynx show themselves at a later age. A predisposing cause is bad hygiene in its broadest sense. Rheumatism and gout cannot be regarded as direct causative factors, though persons subject to these maladies frequently have sore throats. In the granular sub-variety (see below) exacerbations are often referable, according to Marage,¹ to a hyperacidity of the system, as shown in the urine.

According to this view, granular pharyngitis is nothing but the local expression of a general diathesis. It occurs because there is a general diminution of the mucous secretions in consequence of their acidity. The mucin precipitated by this acidity obstructs the mucous follicles, thereby preventing them from proper function. Gastric acidity is also increased, so that patients often eat more than they really need, and unless self-restraint is exercised they speedily suffer from dyspepsia. Concerning the foregoing view, it may be said that Marage evidently had in mind a condition different from that generally called pharyngitis granulosa. Most authorities place this under the heading of follicular pharyngitis, which has nothing to do with the mucous glands. Bosworth does not believe that the follicular condition ever develops from an antecedent catarrh, though Lennox Browne and Kendal Franks have both asserted the contrary.

¹ Archives Internat. de Laryngol., 1900, vol. xiii. p. 30.

The condition is often called "clergyman's sore throat," suggesting that among the list of causes must be included improper vocal effort. This has reference not alone to overforcing of the voice but to its use under unfavorable conditions, such as speaking when the throat is inflamed, voice-use by venders in the noise of the streets, by hucksters in all sorts of weather, etc. Political orators suffer from this form of throat trouble, especially as most of them are utterly deficient in the art of conserving their vocal energies, and are obliged to speak again before the fatigue of a previous effort has been recovered from. The voice muscles must have periodical rest like other organs. Seiler has described this fault as a "repeated transgression of the normal registers of the voice."

FIG. 178.



Follicular pharyngitis, with adherence of pillars to faucial tonsils. (Kyle.)

FIG. 179.



Large follicles on pharyngeal wall. Dilated vessels with enlarged and adherent tonsils. (Kyle.)

Pathology.—The follicular process is distinct from the beginning, though it may be accompanied by a simple superficial catarrh. The process may take the form of a universal diffusion over the pharyngeal wall, thus presenting a finer or coarser granular appearance, or may assume a localized form behind the posterior faucial pillars, appearing as ridges or bead-chain-like deposits. These ridges are at times apparently fused with the pillars themselves, though of a darker color. In some cases of the latter character, described by Schmidt¹ as "pharyngitis lateralis," this chain of enlarged follicles has extended down the pharyngeal wall as far as the epiglottis. This variety is called by Heryng the hypertrophic; he also maintains the existence of another form which he calls the hyperplastic, asserting that an actual formation of new connective tissue is found in it, though the situation and gross appearance may be the same as in the more common variety. Either form is easily made out on inspection. The affection of the follicles is most marked near the mouths

¹ Deut. Archiv f. Klin. Med., Bd. xxvi. S. 421.

of the muciparous glands. The process may be described as a true hyperplasia, an actual increase in the number of the lymphoid elements, especially about the efferent channels of the lymph-nodes. This hyperplasia may be diffused through the deeper as well as the superficial lymphatic structure of the mucosa, causing a general thickening, or it may appear as blunt masses projecting but slightly from the surface. In the earlier stages these masses have a soft consistency, but in later years they grow smaller and harder, and may even entirely disappear. Their

FIG. 180.



Pharyngitis granulosa. (Seifert and Kahn.)

persistence is the legacy of the changes which were set up during the period of lymphatism.

Symptoms.—The most prominent symptom is a disturbing pharyngeal sensation, which may be called “dysæsthesia” of the pharynx. This is due to the unusually rich nerve-supply of the pharyngeal mucosa and also to the fact that the nerve-endings are involved in the hyperplastic nodal changes. It varies from a mere uneasiness to an actual pain, and excess of vocal effort aggravates the discomfort. Swallowing is often painful. The abnormal sensations have been looked upon as true neuralgic pains due to increased circulatory activity through the follicles. Secretion is not, as a rule, increased, though it may be blood-streaked from

rupture of a superficial vessel. Sometimes the follicles appear to lie on a bed of whitish connective tissue, and the whole area seems very dry. This is the "pharyngitis sicca" of some writers. It must be added that many authors regard the latter condition as a distinct form of pharyngitis without any true inflammatory element and due directly to trophic changes, continued irritation, or venous engorgement. The voice is of a husky character, probably from a reflex influence upon the muscles of phonation, and a dry, nervous cough gives more or less annoyance. From time to time the severity of the symptoms will vary according to the variable neurotic factor in each individual.

Associated with the foregoing an elongated uvula is frequently found, especially in connection with a chronic pharyngitis. The faucial and lingual tonsils are often enlarged, the former adhering to the pillars. Enlarged veins may course over the pharyngeal wall, though this is not an essential feature of the condition. The disease may continue indefinitely, remaining localized, but there does not appear to be any conclusive evidence that it predisposes to tubercular infection of the upper or lower air-tracts.

Treatment.—In regard to general measures, the same plan may be followed as suggested under the heading of simple chronic pharyngitis. The local treatment consists in the removal or destruction of the enlarged follicles, and for this purpose all sorts of caustics have been used, nitric, chromic, trichloroacetic acids, the actual and electro-cautery, and for the larger hypertrophic and hyperplastic masses the knife. An amply sufficient method of cauterization, if one has not the more elaborate apparatus at hand, is to use as the destructive agent a small iron wire heated in the flame of a spirit-lamp. The wire (of the size of a knitting-needle) should be heated to a dull red and thrust directly into the follicle. If the masses be broad the wire can be bent, and its surface rather than its point used in a similar manner. The ease of manipulation of the galvano-cautery makes it the ideal agent. Six or eight punctures at different sites can be made at one sitting, and the injection, by means of a curved needle, of a drop or two of a two per cent. solution of cocaine into each field of puncture renders the latter painless. In any event, it is not much more painful than the needle itself, so that many operate without the cocaine, on the principle that one puncture is better than two,—one for needle and one for cautery. Reaction is not, as a rule, severe; it is more pronounced on the lateral than on the central areas of the pharyngeal wall. The minute slough comes away in five or six days.

For the larger masses Stoerk, and more recently Emil Mayer, have recommended thorough curetting of the entire diseased area at one sitting. Bleeding is slight. In some instances a lymph exudation forms, but this generally disappears in a few days, while pain rarely lasts more than twenty-four hours. Mayer found that no cicatricial tissue resulted, and that the curetting was not attended with danger to healthy tissue.

As regards internal remedies, the use of potassium iodide in small doses is advised, and the employment of various mineral waters, the continuous current, etc., may be of indirect service in improving the general nerve-tone, on which depends the severity of the symptoms; but such measures can hardly affect the local hyperplastic changes. Most writers insist upon the interdiction of tobacco and alcohol. Bosworth is disposed to be somewhat more lenient as to alcohol in moderation, though he coincides with the majority as to the baneful effects of tobacco on catarrhal conditions of the upper air-tract characterized by lymphoid hypertrophy. Whenever a cure of the follicular trouble has been effected, tobacco may be resumed in moderation. In neurotic patients the use of strychnine, arsenic, phosphorus, etc., together with cod-liver oil and hypophosphites, is of great advantage.

RETROPHARYNGEAL ABSCESS.—This is a condition frequently overlooked, but one always to be borne in mind whenever a child comes under observation suffering from difficulty in breathing and swallowing without obvious cause. Its importance is owing to the fact that rupture may prove quickly fatal from aspiration of the pus into the lower air-tract.

Recent anatomical studies by Charpy and Escat show that there is behind the pharynx and œsophagus a flat shallow cavity, limited behind by the aponeurosis covering the spine and in front by a sheath of connective tissue. The lateral boundaries are partitions from the lamellar sheath to the aponeurosis just mentioned. The cavity reaches above to the basis cranii and below to the mediastinum, and its contents are certain sympathetic ganglia and lymph-nodes. Into the latter drain the lymph-channels of the neck, nasopharynx, and pharynx. External to its lateral boundaries are important vessels and nerves. It is in this space that the abscess forms.

Etiology.—As a rule, inflammation begins in the lymph-nodes and extends to the cellular tissue, but it may begin in the latter if there has been any trauma, as from instrumental irritation or a foreign body. Any infection may set up an abscess here; hence in children, in whom the condition is far more common than in adults, the exciting causes are infectious maladies, erysipelas, acute inflammation of the pharynx or of its lymphoid deposits, otitis media, etc. In one case (Liebert's) the condition was ascribed to an antral empyema, for as soon as the latter was cured the retropharyngeal abscess disappeared. A predisposing cause, as diminishing the power of resistance to infection, is found in impaired nutrition, especially that referable to syphilitic, tubercular, and lymphatic diatheses. W. P. Northrup reported to the New York Pathological Society¹ a case with tubercular meningitis and calcareous bronchial nodes. The patient was a boy aged three years, without any ante-mortem trace

¹ Cf. Sajous's Annual, 1891, vol. iv. E. p. 3.

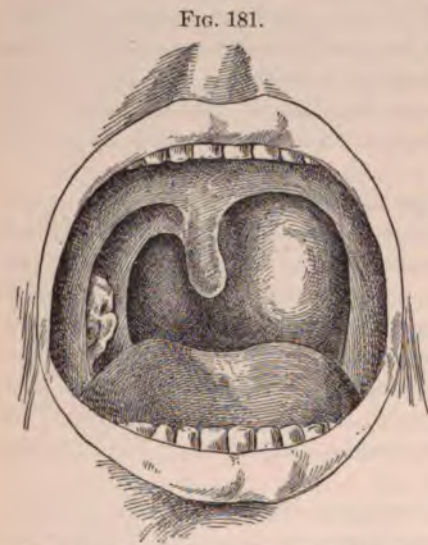
of tuberculosis, yet a tubercular nodule was found in an apparently healthy bronchial gland. The case was reported as emphasizing the importance of searching for latent tubercular deposits and also to call attention to the fact that the oldest process will often be found in the lymph-nodes adjacent to the respiratory tract.

Pathology.—The process in these cases is one of pus formation, which, owing possibly to the proximity of the digestive tract, may be offensive. The sac contents are thick and yellow; the abscess may be in the middle line or, if high up, to one side, and burrowing is sometimes extensive. The pus-pocket may be unilocular or multilocular.

Symptoms.—In infants there is a sudden refusal of the breast, with a snuffling, metallic cry, possibly dysphagia, and even dyspnoea. In older

children the usual symptoms of sore throat with febrile reaction are found, and in such there is little difficulty in making a diagnosis by inspection; but in the youngest patients palpation may be necessary to locate the phlegmon, and the mouth-gag should be used if necessary for careful exploration. A soft boggy spot will be felt, in which at times a distinct fluctuation can be detected. In the most marked cases there will be a lateral cervical swelling, but no time should be wasted in waiting for the appearance of this feature. There is sometimes a forward bulging of the soft palate.

The principal danger previous to rupture is oedema of the larynx with displacement of the entire or-



Retropharyngeal abscess, phlegmonous variety.
(Bosworth.)

gan forward, thus causing asphyxia. Respiration and deglutition grow progressively more difficult. Pulmonary complications sometimes arise, and infiltration of pus into the cervical tissues may occur, with death from septic absorption. The most common danger is that of rupture during sleep, in which case the child may speedily be asphyxiated.

Course and Duration.—These vary greatly. Cases are on record in which purulent accumulation has occurred in twenty-four hours, while others are prolonged over several weeks or (if tubercular) months. The ordinary case comes to a focus in from six to eight days.

Diagnosis.—Differential diagnosis is required from coryza, the various forms of tonsillitis, croup, and even diphtheria. Certain cases in which the general symptoms have been pronounced and local trouble slight

have been mistaken for typhoid fever, but careful examination and *palpation* will generally locate the abscess definitely.

Treatment.—Immediate evacuation is advised. In an ordinary case the child should be held in a good light with opened mouth, and with a protected blade an incision should be made from about the middle of the sac down to its bottom. The finger *in situ* guiding the blade should then be passed into the incision, thoroughly opening up the sac and thus securing complete drainage. Immediately after the primary incision has been made the patient should be inverted, so as to allow the sac contents to drain out of the mouth. The incision may be made with the head already thrown forward, and the finger will prevent the refilling of the sac. Ingals has reported one case in which, four months after opening, a fistulous tract was discovered at the base of the tongue, through which a small catheter passed down, as judged by the pain felt, to the neighborhood of the right breast, a distance of some thirty centimetres. A theoretical danger of opening in the manner above described is that of striking the carotid artery, which may be misplaced by abscess pressure; but, unless there is pressure from the external cervical area, the abscess will rather tend to direct the large vessels outward. Piatot has recorded one case in which sudden death occurred on making the incision. No cedema of the glottis was present, but the pneumogastric nerves had been stretched and pushed back by the abscess. Death was ascribed to reflex syncope, though no satisfactory reason therefor could be assigned.

In cases in which there is much cervical bulging, external incision has been recommended.

CHAPTER V.

VASCULAR ANOMALIES AND PARASITIC DISEASES OF THE PHARYNX.

AN abnormal vascular condition not infrequently seen is that of unusually large and pulsating vessels on the posterior and lateral walls of the pharynx. The vessel usually affected is the ascending pharyngeal artery, as determined by its position on the superior constrictor and its vertical direction. Dissections have shown that when the ascending

palatine artery is small the ascending pharyngeal is correspondingly large, so as to furnish sufficient blood to the area supplied.

Cases of this nature have been reported by many observers. The condition is generally unilateral, though Farlow has seen two instances of bilateral enlargement. At times the area of pulsation is so distinct and localized as to suggest a true aneurism, but generally the affected area is a linear one along the surface under the mucosa; if projecting therefrom, it is a knuckle of the arterial tube bulged out from the natural course of the vessel. McBride¹ has seen one case in which the posterior pillars themselves seemed to pulsate, but an enlarged vessel was



Ascending pharyngeal arteries of abnormal size. (Farlow.)

found immediately behind, and a systolic bruit was audible. In a second case a pulsating mass suspected to be an aneurism proved to be a cyst. In a third case the patient suffered from a tinnitus compared to the hissing of escaping steam; in this instance many of the bodily arteries visibly pulsated, and the right radial ran an abnormal course. In the pharynx pulsation was visible on both sides at the junction of the posterior and lateral walls; on the right side the pulsation was communicated to the tonsil.

In other instances, such as that reported by A. Brown Kelly, the pulsating vessel has been regarded as an abnormally flexuous internal carotid bulging towards the posterior pharyngeal wall. Of course, an

¹ Edin. Med. Jour., December, 1896, p. 510.

aneurism may occur, as in Richardson's case,¹ in which the swelling extended from a point a little to the right of the median line to the lateral wall of the pharynx, and from the level of the base of the tongue to that of the lower edge of the palate. A bruit was audible, disappearing under pressure on the common carotid. Rosenthal² reports a case of true aneurism the size of a coffee bean located at the origin of the right pharyngopalatine pillar. Pulsation ceased on compression of the right carotid. Uhl³ has seen one case of traumatic aneurism of the descending palatine.

In addition to pulsating arteries, pulsating veins have been noted by Sanderson and Cresswell Baber. Normally there exists on the posterior and lateral pharyngeal walls a net-work of veins with meshes of unequal size, the principal channels of which empty into the internal jugulars and communicate posteriorly with the pterygopalatine vessels and median and posterior meningeals. This plexus is the terminus for the numerous veins coming from the muscles. According to Bimar and Lapeyre, there is at the level of the inferior portion of the posterior pharyngeal wall a very remarkable deep plexus seen at all ages; it lies between the mucosa and inferior constrictor, partially concealed by the inferior angle of the middle constrictor.

The foregoing are typical descriptions of these cases, many more of which might be cited. The writer has seen several such, and nearly every year one or two are presented at the section meetings of the New York Academy of Medicine. In considering this class of anomalies two facts should be noted. The first is, that the vast majority of them present no symptoms whatever, and the existence of the abnormality is unknown until the patients happen, for one reason or another, to undergo a systematic examination. The second fact has reference to the possible occurrence of alarming, even fatal, hemorrhage from operations performed under these circumstances. From the site of some of the vessels it is evident that the incision for an ordinary quinsy would not be free from danger, and the same remark applies with still greater force to the removal of lymphoid hypertrophy from the pharyngeal vault. The caution is suggested that careful palpation should in this region precede every use of the knife. If enlarged pulsating vessels are found, the field of operation should be carefully circumscribed, and it may be that operative intervention is entirely out of the question.

HEMORRHAGE FROM THE PHARYNX.—Hemorrhage from the pharynx may arise from three sets of causes. 1. Trauma, as from a foreign body, surgical procedures, violent hawking, etc. 2. Changes in blood composition, and possibly in the vessel-walls themselves, which permit

¹ Jour. Am. Med. Assoc., August 2, 1890, p. 180.

² Rev. de Laryngol., 1896, vol. xvi. p. 1185.

³ Münch. Med. Wochen., May 21, 1895, S. 495.

the hemorrhagic,—but all the causes in the list of cases given by him can be brought under one or other of the forms of pharyngitis.

Treatment.—The treatment of the foregoing line of cases consists in the application, if possible, of some coagulating agent directly to the point of bleeding when this can be located. Cocaine and suprarenal solutions may be used, followed by antipyrin in four per cent. solution, and later by a styptic, such as silver nitrate, or even the cautery at a dull red heat. Ice-pellets may be held in the mouth, and the familiar gargle of Mackenzie (gallic acid one part, tannic acid three parts, water four parts) slowly *sipped*. These measures will generally prove efficient. The condition of the kidneys should be looked after, for a coexisting albuminuria gives a clue to the real source of the trouble. Food should be bland and unirritating, and for the first twenty-four hours after the occurrence of the bleeding all hot ingesta should carefully be avoided.

PARASITIC AFFECTIONS OF THE PHARYNX.

The parasites most commonly found in the pharynx and adjacent areas are the *oïdium albicans*, *actinomyces*, *aspergillus fumigatus*, *bacillus fasciculatus*,—the growth causing that rare affection known as *nigrities linguæ*, or “black tongue,”—and the different varieties of *leptothrix*. The pharynx is rarely affected alone, but shares in all the mycotic affections of the buccal cavity. In this chapter but two conditions are spoken of,—thrush caused by the *oïdium albicans*, and *leptothrix mycosis*.

THRUSH.—In young children thrush often affects the soft palate and the posterior pharyngeal wall, and is generally a manifestation of some acute or chronic digestive disturbance. In adults thrush is rarely seen except in wasting maladies running a long course, and even here only in severe types of the various affections, though it may occur in acute pneumonia. Damaschino and others have reported a series of typhoid fever cases in which the thrush seemed to assume the character of an epidemic. Duguet (quoted by Schech) states that in children the affection spreads from the mouth to the pharynx, while in adults the reverse course is followed. This, however, is a matter of minor importance.

Oïdium.—The *oïdium* is a genus of hypomycetous fungi (naked spores or prominent threads) the species of which are now regarded as transitional forms of other fungi. The special one concerned in the production of thrush (muguet) is the *albicans*, the filaments and spores of which make up the white patches or coatings on the mucosa.

Symptoms.—The symptoms of this form of parasitic disease, apart from those of the general condition with which it is associated, are generally limited to a feeling of discomfort in the throat, though in some cases there are burning and lancinating pains and nausea. Children occasionally find difficulty in the swallowing and regurgitation of food. Inspection readily reveals the local condition, though the microscope may be necessary to positively assure one's self of the identity of the fungus present. Re-

removal of the mass is somewhat difficult, in spite of the superficial nature of the deposit. In some instances the mycelial threads of the parasite penetrate not only the epithelial layer of the mucosa but actually pierce it, and reach even the subjacent muscular layers. A little bleeding generally follows its removal, and shedding of the epithelium together with superficial erosions have been observed.

Under the microscope the mass removed shows various epithelia and schizomycetes and numerous filaments of the *oidium albicans*, unequally jointed with lateral branches and buds. The filaments show violet-colored cavities filled with granules; their ends are rounded off and covered with small bleb-like bodies, and, in addition, close to the filaments are the so-

called conidia, or fruit spores.

FIG. 183.



Oidium albicans. (Bresgen.)

Treatment.—The treatment of this condition should be mainly preventive, and consists in the proper hygiene of the oral cavity. In all kinds of sickness the throat should frequently be inspected, and if whitish patches of any kind are found their nature should be ascertained. The patient's general condition will be of great assistance in arriving at an accurate conclusion. The mouth should always be cleansed after taking food, and in case the pa-

tient is not able to rinse it, it should be carefully wiped out with a soft cloth over the finger, and moistened with, preferably, some weak alkali, such as sodium or potassium carbonate or borax, all in watery solution. The addition of honey to the latter nullifies its action, for the *oidium* feeds on sweets. In adults the mouth should first be cleansed with cold water and then silver nitrate solution, not exceeding in strength ten grains to the ounce, applied. This treatment will generally effect a cure.

PHARYNGEAL MYCOSIS—MYCOSIS LEPTOTHRIXEA.—In 1873 Fränkel first observed a fungus producing a pharyngeal affection, to which he gave the name of mycosis tonsillaris benigna, and which was called by Heryng pharyngomycosis leptothricea. Later observation has shown that not only are the tonsils affected, but also the tongue, pharyngeal wall,

faucial pillars, deeper recesses of the lateral pharyngeal folds, epiglottis, and, rarely, the nasopharynx, larynx, and nose. The fungus clings to the epithelium, and often prefers a healthy to a diseased mucosa. The objective appearance is that of whitish or yellowish-white excrescences, either soft or of a horny hardness, and often with thorny tufts. They are due to the growth of the leptothrix, which is described below.

Predisposing Causes.—These include previous inflammations and carious teeth. The fungus growth frequently follows acute tonsillitis, and has doubtless often been mistaken for chronic lacunar inflammation. A rheumatic tendency has been observed in some cases, though there is no certain connection between the two. This particular parasite belongs to the normal flora of the healthy human mouth; consequently any lowering of general vitality, or any persistent change in the chemistry of the oral cavity, may bring about conditions which will allow of an abnormal development of this or other parasites.

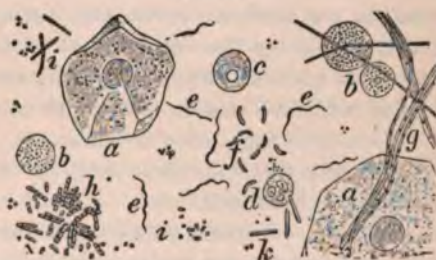
The Leptothrix.—The deposits generally appear embedded in the crypts of the mucosa covering the tonsils, or on other areas where the cryptic element of the mucosa is not so pronounced. They project above the surface, are horny in consistency, and are removed with difficulty. Sometimes when not actually embedded they seem to cling to the surface like lichens. They sometimes appear as isolated deposits of varying size, or may be connected by threads running from one tuft to another and interlacing like the tendrils of a running vine.

If a bit of deposit be torn off, teased in glycerin, and examined with a low power of the microscope, there will be found a mass of epithelia (an accidental circumstance) surrounded by irregular granules in which are embedded the spores of the various species of the leptothrix fungus. The general appearance of the microscopic field is well illustrated by Fig. 184. These spores are arranged in link-like processes, their ends being rounded or club-shaped. The latter vary in length, and sometimes curl up at the end into hair-like filaments. Others are like colorless rods, but with sharp dark borders, the centres

seeming to be full of dark granular matter. Besides these spores there are round or oval, highly refractive bodies with dark borders, arranged in colonies or placed separately between the branching spores. The whole forms a net-work composed of spores and refractive granules.

No one has thus far succeeded in cultivating the fungus outside of the

FIG. 184.



Buccal secretion. (Von Jaksch and Cagny.) *a*, epithelial cells; *b*, salivary corpuscles; *c*, fat-drops; *d*, leucocytes; *e*, spirochaeta buccalis; *f*, comma bacilli of the oral cavity; *g*, leptothrix buccalis; *h*, *i*, *k*, different forms of fungi.

germicidal power, thus, as it were, rendering the surface of the mucosa immune. St. George Reid believes that the saliva offers a distinct bar to the acclimatization of the tubercle bacillus. The mouth is always teeming with all sorts of bacterial life, and it may well be that the struggle for existence of some of the more hardy varieties sets up conditions which are inimical to the development of tubercle bacilli. As indicated above, the attack on the fauces is generally secondary to infiltration elsewhere. Here the lymphatics are the channel of infection, but the latter may arise from direct inoculation. The theory that inoculation takes place from contact with sputa is hard to credit, else the disease would be much more common.

Pharyngeal infection may arise through the blood,—*e.g.*, miliary and other forms of tuberculosis through the lymph-glands, though the reverse route is more common,—through the inspired air, and through the food, especially milk and flesh infected with bovine tuberculosis. It is not necessary that there should be a solution of continuity of the pharyngeal or tonsillar tissues, for, according to Strauss, the bacillus can effect an entrance through the epithelium. Krückman finds that in adults the tonsils and cervical glands are usually infected by the bacillus after the lungs become the seat of the disease. According to Price Brown, Abercrombie and Gee have reported cases following tuberculosis of the bowel.

Pathology.—Concerning the gross appearances of tuberculosis of the pharynx, Kafeman distinguishes two forms: one is the ordinary miliary tubercle, which is distributed over the mucosa, and the other is a papular lesion, which may be restricted to one or two small areas, and is especially apt to appear on the posterior surface of the soft palate. Both show under the microscope a small, round-cell infiltration of the connective-tissue elements, followed by an extension of the process into the vessel-walls, gradually narrowing the lumen. Later endarteritis, obliteration, cheesy softening, and ulceration follow. According to present ideas, tubercle bacilli must be present, but clinically it is difficult, or even impossible, to find them in the scrapings from the surface or even in bits of tissue removed for staining. The same may be said of the so-called giant cells.

The mucosa as a whole looks anæmic, and this anæmia may be due either to the endarteritis or, according to Wyatt Wingrave, to a toxic vaso-constriction. The uvula and soft palate are studded with small whitish points, apparently beneath the surface, and showing through the mucosa. In the cases called primary—that is, where one is unable to demonstrate the existence of any other tubercular lesion—the deposit is apt to assume the form of a fringe of small excrescences extending along the anterior pillars. In other places only an irregular infiltration is found, with nothing about it especially distinctive, at least in its earlier stages.

After a variable time these deposits break down and form a characteristic ulcer, with reddish, eroded edges, and possibly a localized peri-

there is generally a persistent discrete arrangement of the patches, neither fever nor surrounding inflammation is present, the masses are harder than false membrane, and the tongue may be involved.

In lacunar tonsillitis there are usually marked constitutional symptoms which are often out of all proportion to the extent of the lesion and signify the absorption of septic material. The mucosa between the lacunæ is inflamed. The exudate is easy of removal and is not friable.

Tonsillar concretions contain, as will be seen farther on, a great variety of substances, including leptothrix threads, but when the crypt containing the concretion has once been cleaned out the latter does not readily form again. The mycotic deposit, on the other hand, constantly tends to recur.

Treatment.—All dietetic errors must be corrected, the digestive tract put in order, and the teeth properly cared for. These measures alone have cured several cases in the writer's practice. A change of climate will cure some cases which have obstinately resisted all forms of treatment.

Topical measures include the use of caustics, and for this purpose nearly every caustic remedy in the Pharmacopœia has been recommended. The list includes solutions of zinc chloride, balsam of Peru in alcohol, iodine and carbolic acid in glycerin, salicylic acid in alcohol (four per cent.), borax, mercuric chloride, chromic acid, silver nitrate, and pyrozone, or the caustic solution of hydrogen dioxide. Smoking is credited with having cured one case, but it is dangerous to apply solutions of nicotine. Some of the larger deposits may be removed with forceps. If the process is localized on the tonsils, and it is possible to remove these organs entirely, this should be done. Salol and the alkalies have been given internally on the theory of a rheumatic origin of the affection.

The weak point with all topical applications is that they are, at best, superficial in action. Whatever theory may be entertained of the nature of the malady, the physical condition to be treated is that of fungous masses growing from depressions in the mucosa, and these should be thoroughly extirpated. The best plan is to destroy the roots of each deposit by means of the galvano-cautery passed deeply into each crypt. The process is tedious, but any less energetic measures will only waste time, disappoint the physician, and disgust the patient. In cases in which the cautery is unavailable, chromic acid fused on the end of a probe is the best substitute.

CHAPTER VI.

TUBERCULOSIS, LUPUS, AND SYPHILIS OF THE PHARYNX.

TUBERCULOSIS OF THE PHARYNX.

THIS is one of the comparatively rare manifestations of tubercular infection, and in its primary form occurs in only about one per cent. of all cases of acute tuberculosis of the upper air-passages. Rosenberg¹ found only twenty-two cases out of twenty-two thousand clinic patients. Secondary involvement is seen in nearly twenty-five per cent. of all fatal cases of pulmonary and laryngeal infection, but statistics vary as to the frequency of the secondary form. Levy² found seventeen instances out of one hundred and sixty-two cases of tubercular disease; in this group, however, eleven presented accompanying laryngeal infection. Variation in figures is not to be wondered at when it is considered that at the time the local diagnosis is made it may not be possible to detect the exact site of other deposits in the body, although the physician may be reasonably confident of their existence. As expressed by Price Brown, the existence of the pharyngeal deposit is assumed to indicate the presence of general tuberculosis in other parts of the body. That there is such a thing as primary pharyngeal tuberculosis is, however, beyond all question.

As opposed to the rarity of this form of tuberculosis is its virulence. Bosworth states that "it would seem that a deposit of miliary tubercle in the mucous membrane of the respiratory tract assumes a peculiar virulence as the seat of the deposit is in portions near the outer world."

The uvula and soft palate are the favorite sites of invasion. In fourteen cases of pharyngeal tuberculosis studied by Wroblewski, the faucial pillars were affected in all and the uvula in ten. In the primary cases it would appear that the right side is the one more frequently invaded, but the reason for this is unknown: it may be due to peculiarities in lymphatic distribution. The anterior surfaces of the pillars and palate suffer most, then the tonsils, posterior pharyngeal wall, and hard palate.

Much has been written in recent times concerning tuberculosis of the tonsils, especially the so-called "latent" tuberculosis. Ruge³ made microscopical examinations of the tonsils from seventeen individuals, seven of whom had deposits in other organs. In five out of the seven tubercle bacilli were demonstrable in the tonsillar tissues. These cases had also pulmonary disease. Similarly, Strassmann found bacilli in thir-

¹ *Rev. de Laryngol.*, November 15, 1895, p. 1079.

² *Denver Med. Times*, June, 1896.

³ *Virchow's Archiv*, 1896, Bd. iii. S. 431.

Treatment.—In addition to tonic and hygienic treatment of tuberculosis, a vigorous effort should be made to keep the patient as comfortable as possible, even though he steadily deteriorates. Climatic changes do not seem to be of much avail in palatal and pharyngeal tuberculosis. All causes of buccal irritation should be removed, the teeth placed in perfect order, and the food soft and pultaceous in consistency, though an effort should be made to have as great a variety as possible. The patient sometimes finds it easier to gulp food down than to chew and swallow it in the usual way, or he can lie on the stomach and draw liquids up through a tube. As soon as the existence of tubercular tissue is ascertained, an effort should be made at eradication. Curetting under cocaine, with the subsequent rubbing in of lactic acid, forms the plan most in vogue at the present time. The ulcerated surfaces should be regularly cleansed with hydrogen dioxide, then with a weak alkaline solution, and finally dusted with iodoform, eucrophen, aristol, or some similar powder. Menthol in olive oil (twenty per cent.) has had enthusiastic advocates, but is not used as often as formerly. Applications of morphine with tannic acid, or even cocaine, may be made for the pain, but the habitual use of the latter should be deferred as long as possible. Orthoform is here of value, and may be applied according to the formula of Freudenthal :

	Grammes.
R Menthol	10·0
Olei amygdal. express.	30·0
Vitelli ovi	30·0
Orthoform.	12·5
Aque destil. q. s. ad	100·0

This mode of preparation insures its contact as long as possible with the affected areas. If it is applied in powder it may be mixed with equal parts of zinc stearate or bismuth subcarbonate. It is distinctly analgesic, and seems devoid of toxic properties. A few cases are on record in which, after its too extensive application to superficial wounds, there ensued headache, with fever, nausea, and dusky erythematous patches over various areas. For the cough, heroin in doses of from one-sixteenth to one-twelfth grain may be given every two or three hours. Some authorities prefer to operate with the galvano-cautery. The use of potassium iodide may reveal the true nature of a doubtful case.

LUPUS OF THE PHARYNX.

At the present time lupus is regarded as an attenuated form of tuberculosis. It is fully recognized that while in the majority of cases of pharyngeal lupus the disease begins in the skin, it is possible for it to primarily attack the tissues of the throat. One may go further, and say that many cases of facial lupus really begin in the nasal mucosa, but are not recognized, owing to the painless character of the malady, until the

affection is far advanced. It is difficult to assign a definite cause for those cases in which the pathological process first appears in the fauces. Concerning the causes of lupus in general, Harries and Campbell, as quoted by Browne, give three factors: first, a suitable soil of undetermined nature, possibly allied to scrofula or tubercle, yet not identical with either; second, a predisposing cause, perhaps a remote trauma; and, third, an exciting cause, possibly a micro-organism. Browne adds that all of his own cases have, with one exception, been in persons of a distinctly lymphatic temperament. It is well known that women are more often affected than men. This, however, is contrary to the experience of De la Sota.¹ Some of the latter's patients were scrofulous, others syphilitic, still others herpetic, and in one the only diathetic influence manifest was the rheumatic. The favorite age is between twenty and thirty years.

The exact relation of lupus to tuberculosis is still a matter of discussion. As stated, the profession is at present working on the basis of Marty's appellation of an "attenuated tuberculosis." On the supposition that the germs of the two are identical, it has been suggested that lupus patients are clinically those who possess sufficient vitality to offer a fairly successful resistance to this particular form of bacterial attack. The histological differences between the two lesions are slight. The disease attacks by preference the soft palate and uvula, commonly starting near

FIG. 187.



Lupus of the soft palate. (McBride.)

the free border of the former, and may extend to muscles, tendons, and cartilages, but not, according to Hutchinson, to bones. The first evidence of invasion is an infiltration and hyperplasia of the part, which thus loses its normal contour. The edge of the palate becomes uneven and the uvula presents a bulbous appearance. The infiltration generally shows itself in the form of nodules, which are discrete at first, but which finally coalesce, so that the resulting masses make the surface of the affected area very uneven. De la Sota calls attention to the early presence in the masses of a peculiar elastic resistance. They are harder than ordinary inflammatory deposits, though not as hard as epitheliomatous formations. Hyde states that "in consequence of warmth and moisture the lupoid nodule is here transformed into a moist papillary outgrowth or externally granulating patch." Later there ensues a peculiar ulceration, or rather a wasting away of tissue, not attended by any purulent discharge or necrosis, but by a disappearance of the

¹ Trans. Amer. Laryngol. Assoc., 1886, p. 14.

PLATE X.



Lupus vulgaris of the palate and fauces. Cicatrices, disseminated lupus nodules, and large and small tubercled ridges upon the fauces, the velum, and the hard palate. (Chiari and Riehl.)



Lupus vulgaris of the larynx. Tubercles and ulcerations at the base of the tongue and upon the swollen, crumpled epiglottis; the left ventricular band thickened and tubercled. (Chiari and Riehl.)

previous masses. Healing then results, but not uniformly, forming a hard cicatrix containing strong connective-tissue bands which still further distort the normal contour of the parts. In this tissue fresh granulations are occasionally noted. A given case, therefore, shows healed areas in some places and a continuation of the active process in others.

Symptoms.—As long as the disease is confined to the soft palate and uvula there are hardly any subjective symptoms until ulceration sets in. Some patients complain of a stiffness in the parts. On the advent of ulceration both clearness of phonation and ease in swallowing are interfered with. Subsequent cicatrization may remove both of these symptoms, though if the latter leads to much distortion of the parts, these difficulties may remain, causing much discomfort in the swallowing of food, which may pass up into the nasopharynx. Homolle has seen one case with marked enlargement of the cervical glands. The process is one of comparative painlessness and long duration.

Diagnosis.—The above-mentioned conditions alone will suffice to differentiate the affection from other forms of throat ulceration. It must be remembered that there are forms of faucial syphilis which in appearance closely resemble lupus. In a doubtful case it is a good rule to administer mercury and the iodides for therapeutic diagnosis, and the practitioner is especially helped by so doing, for there is a unanimity of opinion among writers that in true lupus these remedies are not only without benefit, but that they distinctly aggravate the disease.

Prognosis.—The affection is of itself rarely fatal; there is, however, always danger of extension to the larynx. In some cases the throat condition has appeared to be the source of a general or intestinal tubercular infection. Patients may live a long time, subject to great discomfort, because of the physical condition set up by the progressive phases of the disease.

Treatment.—General treatment consists of the same tonic regimen that is followed in tuberculosis. Iron in its various forms, cod-liver oil, hypophosphites, and similar remedies should be given freely. Some patients derive greater benefit from syrup of hydriodic acid. E. Law has reported great improvement in one patient from the use of this remedy,¹ but as gray powder was employed in conjunction with it, the possibility of a specific rather than a lupoid nature of the case is suggested. One must bear in mind the diathetic groundwork of each case, and treat accordingly. Local measures concern the removal of the lupoid tissue. The uvula may be amputated, preferably with the galvano-cautery; other sites of deposit should be thoroughly curetted and then cauterized. For this purpose lactic acid (from five to ten per cent.) is the favorite remedy, as it does not attack normal tissue, a fact which commends it in preference to some of the other common escharotics. The galvano-cautery

¹ Jour. Laryngol., 1896, vol. x. p. 34.

should be employed for this purpose with great caution. Kyle commends the use of a gargle of hydrochloric acid, twenty minims to the ounce; De la Sota a one per cent. solution of resorcin. Holländer has recommended hot air, which causes, he states, a slow and progressive mortification of the lupoid infiltration. It is applied at a temperature of about 300° C., by means of a bellows attached to a metal tube, and experience has shown that a very good scar is obtained, but details as to duration of application, pain, etc., are not given.¹ Spontaneous periods of improvement may occur, regardless of any or all treatment. Injections of tuberculin and potassium cantharidate seem to be without benefit. Cazin² has reported a case with infiltration of the velum and faucial pillars which was cured by an intercurrent attack of erysipelas. Mention may also be made of the benefit received by some patients from exposure to the X-rays or to the ultra-violet rays of white light, the latter method having been elaborated by Finsen, of Copenhagen. With both of the latter plans of treatment some quite brilliant results have been obtained in cutaneous lupus, and, while their application to pharyngeal disease is vastly more difficult, they may be so perfected as to become directly available for this condition.

SYPHILIS OF THE PHARYNX.

Next to the skin, the mucosa of the fauces and pharynx is doubtless most frequently affected by the syphilitic virus. It is rare to find specific lesions confined to this site, but they can be here examined with especial facility.

Other works must be consulted for the results of the most recent observations as to the nature of the specific poison. There is every reason to believe that it is a living organism, though it has not as yet been isolated. It is assumed that the virus has no power to penetrate intact skin or epithelia, and that inoculation implies either a breach in the superficial tissues or the introduction of the poison beneath them, though it may enter either a follicle or beside the hair-roots.³ The period of incubation varies from one to eight weeks; then comes the local lesion, followed by the systemic changes. Unless the latter are influenced by treatment, they may continue for an indefinite time, characterized by latent or quiescent periods. In certain instances it may be impossible to detect the initial changes; this may happen in cases of infection from syphilitic semen or by retro-infection (during pregnancy) from the foetus. The manifestations of the disease in the pharynx and fauces may now be considered, it being premised that previous acute and chronic inflammations predispose to infection.

¹ Presse Méd., October 30, 1897, p. 269.

² Ann. des Mal. de l'Oreille, 1880, p. 33.

³ Lang, Twentieth Century Med., vol. xviii.

The Initial Lesion.—This occurs most frequently on the tonsils, but may show itself on the anterior and even the posterior surface of the soft palate. Examination shows a chancre more or less distinctly marked, which later may become eroded or ulcerated from the irritation which its exposed site occasions, and which is constantly followed by a painless enlargement of the adjoining lymph-nodes and in due time by constitutional symptoms.

Erythema.—This is one of the "secondary" features of syphilis, and appears at any time from the sixth to the sixteenth week after the initial lesion. The mucosa assumes a somewhat purplish color, which has been referred to passive congestion. In the milder cases this lesion is limited to the lips and cheeks, but it may extend over the tonsils, uvula, soft palate, and posterior pharyngeal wall. The areas involved vary in size from a pea to a penny. The erythema is generally a symmetrical one, reaching from the centre to both sides, and shows sharp demarcation from surrounding tissues, especially at the junction of the hard and soft palates. The median line sometimes escapes. In fact, such a demarcation and situation of the erythema at once suggest specific disease, though these features alone do not make the diagnosis positive. The skin may present erythematous or papular lesions, which will, of course, assist in the diagnosis. The foregoing appearance of the throat is often distinguished with difficulty (in the absence of other information) from an ordinary catarrhal condition.

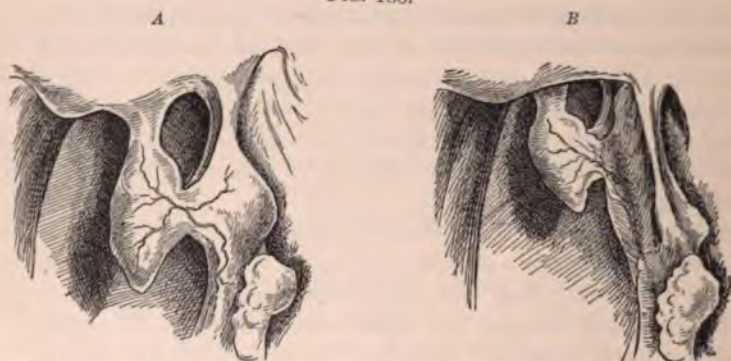
The Mucous Patch.—While this is usually spoken of as a secondary lesion, and is vastly more common in the early stage of specific disease, it is a possibility at any time. It poisons the buccal fluids, and so represents from its potential danger the most infectious stage of syphilis. The patches are ovoid, shallow, and may be symmetrically located. They represent areas in which there is an exudation of serum with a free supply of imperfectly developed cells. These changes cause the very pale color characteristic of the patch. If this condition progresses without treatment, the area itself and a certain zone around it break down, thus forming a superficial ulcer, which dries up, leaving a small stellate cicatrix. Bosworth maintains that the nature of this process is the same as the breaking down of a gummatous deposit (see below), the only difference being that the former is milder and earlier while the latter comes later and is more severe. In either case the essential change in each is one of infiltration of the tissues and of the vessel-walls with embryonic cellular contents, atrophy of the surface, and gradual breaking down. There is no such thing as erosion from the specific virus.

The Gummy Tumor.—This is the distinctive manifestation of the tertiary stage, occurring from five to fifteen years after the initial lesion. A favorite site is on the posterior surface of the soft palate, where the gumma may for a long time be unperceived. Gummata rarely pass over anatomical boundaries,—that is, do not extend directly in front of the faucial

pillars, above the pharyngeal tonsil, or into the larynx. They appear either as nodules or as a diffuse infiltration, and may form rapidly and undergo rapid destruction, the cell-crowding shutting off the blood-supply. These cells are small, round, and embedded in a soft gelatinous basement substance. In the nodular form a bulging mass is found, the mucosa over which is distinctly reddened.

Later these deposits undergo cheesy degeneration, becoming surrounded by a zone of granulation-tissue, which sometimes becomes fibrous. Actual abscess formation is not unknown, though this phase of degeneration is more apt to occur in internal organs than at the site under consideration. Destruction does not pass beyond the confines of the original gummy deposit. Large areas may be destroyed, while strings or bands of fibrous tissue reach from one part to another, completely distorting the pharynx. As a result of new physical relations of the parts involved,

FIG. 188.



Adhesion of uvula to faucial pillars; ulcer in left tonsil. (Lennox Browne.) A, state of repose; B, contraction on inspiration.

regurgitation of fluids into the nose in the act of swallowing is apt to occur; also the soft palate may become adherent to the posterior pharyngeal wall. As a rule, this adhesion is not complete, there being left a small aperture which may be hard to locate; but cases of complete adhesion have been reported. The destructive process sometimes affects the hard palate, so that it is possible to look directly from the pharynx up into the antral cavities adjoining the nose. Erosion of large vessels occasionally occurs.

Gummatous infiltrations are more rarely absorbed in the pharynx than elsewhere, and most of them go on to ulceration. Lang states that, as a rule, the process in both buccal and pharyngeal cavities is exceedingly sluggish as regards individual foci of infection, and also with respect to the formation of new nodules during the presence or after the healing of old ones. He likewise calls attention to the fact that gummata may here

rarely run an acute course, so that within a few days a frightful destruction of tissue takes place, such as would not ordinarily have occurred until after the lapse of months or years.

Symptoms.—The initial lesion is more frequent in men, especially those with enlarged or previously inflamed tonsils. The antecedent condition favors infection by presenting a territory of impaired epithelial integrity. The patient complains as of an ordinary sore throat, the pain being greatly increased by attempts at swallowing. Cervical adenopathy comes on early, and local suppuration in the glands has been observed. Constitutional symptoms are rarely present at this time, and diagnosis from a malignant growth is sometimes required. Early eruption, say in from two to four weeks, will resolve all doubt, and it is a common experience that many ulcerations of an indefinite nature, so far as their appearance is concerned, clear up under the use of the iodides.

In erythema there are a peculiar stiffness of the throat and pain on swallowing. Localization of the erythema in the soft palate and faucial pillars or its sharp demarcation generally enables the practitioner to make a diagnosis without difficulty.

In the mucous patch there is usually extreme sensitiveness, which is increased by irritating ingesta, by tobacco, and by the use of the voice, and may become so acute as seriously to interfere with the patient's nutrition. Diagnosis is made from the fact that the patches generally appear in groups, occurring in order of frequency (Bosworth) on the soft palate and uvula, anterior surface of the anterior pillars, tonsillar convexities, and anterior surface of the posterior pillars. The author just quoted also notes that a collection of patches on one side may reproduce itself on the other in an absolutely symmetrical way, and the reason assigned for this is the contact of the parts in swallowing, during which the two sides are brought into complete apposition. Older patches may be cracked or fissured, with a zone of inflammation which is wanting in the earlier stages. A fresh patch looks as if the mucosa had been lightly brushed with a strong solution of silver nitrate. A few cases are on record in which the patch has assumed the gross form of a fibrinous exudate and has been mistaken for diphtheria, having been attended by marked constitutional symptoms.

The gumma gives symptoms which are mainly mechanical, affecting swallowing and speech. When ulceration has begun, pain may become severe. Contrary to the secondary manifestations, the disease begins as

FIG. 189.



Active tertiary ulceration of the pharynx, with old scar formation. (Lennox Browne.)

a unilateral one, usually first showing itself in one of the tonsils and the adjoining pillars or on one side of the posterior pharyngeal wall. The typical tertiary ulcer is deeply excavated, with sharply defined edges, surrounded by a red, angry-looking area, and pouring out an abundant bright yellow purulent discharge.

Diagnosis.—While advanced conditions are not likely to offer any special difficulty in diagnosis, it may not be so easy to determine the existence of syphilis when the case is seen before the appearance of any but faucial lesions. Many of them present only catarrhal symptoms, with, at times, a little general disturbance. The physician should search for enlarged glands, and may find in the mouth thick, tenacious secretion, causing difficulty in speaking and swallowing. The important point is to regard with suspicion all cases which do not yield to simple anti-catarrhal remedies, although there may be no history of specific disease and no other evidence thereof than the obstinate throat discomfort. The sequel most to be feared is the deformity of the pharynx, which may assume all sorts of shapes, and which has already been mentioned.

In regard to the diagnosis of the disease in its earlier phases, mention may be made of the so-called "Justus Blood-Test," concerning which an interesting article has been written by D. H. Jones.¹ The test is based on the alleged fact that a single inunction of mercury in all untreated cases of congenital, secondary, or tertiary syphilis causes a reduction in the hæmoglobin, due to the sensitiveness of the red blood-cells to the action of the drug, while in non-syphilitics no reaction follows. Jones reports an experience with fifty-three cases, but concludes that the test is by no means an infallible one.

Treatment.—This should in all cases be prompt and energetic. Mercury and the iodides must be given in such sequence and combination as the individual case demands. Alcohol and tobacco must be absolutely forbidden, and care taken that the food be bland and unirritating. Hygiene of the mouth must be enforced by the use of a soft tooth-brush and rinsing after meals with some antiseptic solution of weak strength. If deglutition be extremely painful, a weak solution of cocaine may be used at first, care being taken not to exceed a safe internal dose. Local lesions should be thoroughly cleansed with an alkaline spray (Dobell's) or with hydrogen dioxide diluted with one-third lime-water. The parts may then be dusted with iodoform or, better, orthoform; if possible, this should be done each day. For home use as a cleansing wash, and for a direct effect upon the lesion, the familiar "black wash" diluted with an equal bulk of water may be used for the early, and bichloride of mercury (1 to 3000) for the late, lesions. Each mucous patch should be touched with silver nitrate. Indurations of the mucosa may be painted with a solution of bichloride of mercury (gr. ii) in sulphuric ether (3 v),

¹ New York Med. Jour., April 7, 1900, p. 513.

while a ten per cent. solution of iodoform in ether may be sprayed on fissured ulcers. If palatal perforations have resulted, it is sometimes possible, if they are small and recent, to heal them under the combined effect of constitutional treatment and application to their edges, on alternate days, of mono- or trichloroacetic acid.

For the relief of after-deformities many plans of treatment have been devised, but no general rule can be laid down. Some patients show tissue damage which is irremediable, and the features of each case must be studied by themselves. The main problem after separation of adhesions is to prevent their recurrence. For the separation of the soft palate from the posterior pharyngeal wall there is probably no better operation than the one devised by the late J. E. H. Nichols.¹ Most if not all other operations have the fatal defect that the cicatricial tissue advances in the process of healing from the bottom of the incision; hence the original method of formation of the adhesion is reproduced. Healing begins from the apex of an incision and progresses towards its edge. The denuded surface does not heal at once through its whole extent, for in that case a simple incision would suffice to cure the most pronounced case. Nichols's operation is the application of the principle involved in treating a webbed-finger case. Under cocaine anæsthesia, curved right-angled staphylorrhaphy needles, one for each side, and on long handles, are threaded with silk (No. 13), passed through the median opening into the nasopharynx, and then brought out into the mouth again on each side as far as the shape of the needle will permit, back close to the pharyngeal wall. To the thread is attached one of larger size (No. 16), which is drawn through the same track in the reversed direction. Knots are tied in each of the loops, which are teased along until they lie in the nasopharynx. These loops are left in position for a week or two, attachment being prevented by the movements of the pharynx. At the end of this time the little canal in which the loops lie will have become firm and cicatrized tissue. The loops are then cut and withdrawn, leaving the canal free. A long knife, with its cutting edge at right angles to the handle, is then pushed through the cicatricial canal with its edge towards the median line, and the tissue between it and the central opening is cut through, care being taken not to injure the tissue at the back of the knife,—*i.e.*, the canal made by the needle. In a few days healing of the cut edges will have taken place, but they will remain separated because of the band of cicatricial tissue at the apex of the cut. Thus the nasopharynx will be opened by just so much as the depth of the incision. It may be necessary to repeat the operation several times until adequate space has been obtained. Various sounds, curved to fit the nasopharynx, have been devised from time to time, but the operation above described is the best for all cases approaching complete occlusion.

¹ Trans. Amer. Laryngol. Assoc., 1896, p. 161.

CONGENITAL SYPHILIS OF THE PHARYNX.—Our knowledge of this condition is largely dependent on a careful study by J. N. Mackenzie.¹ Among his conclusions the following are pertinent to the special matter under consideration.

(1) Deep ulceration may invade the pharynx at any period of life from the first week up to the age of puberty. (2) When the eruption of inherited syphilis is apparently delayed until the latter period, the lesions of the palate and pharynx are found with a peculiar constancy, and often first attract attention to the existence of a diathesis of which they are the sole pathological expression. (3) Females are more often attacked than males. (4) Ulceration may occur at any site, but the palate is the favorite one. (5) When situated at the posterior portion of the hard palate, the tendency of the ulceration is to

involve the soft palate and velum and thence to invade the nasopharynx, while when situated more anteriorly, ulceration reaches the nose directly by perforation of the bone. (6) The next most frequent sites of ulceration are the fauces, nasopharynx, posterior pharyngeal wall, nasal fossa and septum, tongue, and gums. (7) Ulceration (especially that of the palate) shows a disposition to centrality with a special tendency to caries and necrosis. This tendency to necrosis exists at all periods of life, but especially in early youth, at which time it is more destructive and



FIG. 190.
Ulceration of velum in congenital syphilis. (Lennox Browne.)

less amenable to treatment. The congenital forms of ulceration show little tendency to invade the larynx (Fig. 190).

Another point of interest mentioned by the same authority² is the fact that these local ulcerations, due to inherited syphilis, are often influenced by any intercurrent febrile affection, notably by measles and scarlet fever (not diphtheria). The supervention of scarlet fever may cause a complete disappearance of the ulcers. The poisons of the two conditions in their circulation in the regions named appear to be mutually destructive, and the throat escapes by virtue of such reciprocal antagonism. Cure may be permanent or relapse may follow the subsidence of the intercurrent affection.

¹ Am. Jour. Med. Sci., October, 1880.

² Trans. Amer. Laryngol. Assoc., 1884, p. 16.

CHAPTER VII.

ERYSIPELAS, HERPES, PEMPHIGUS, AND DIABETIC ULCERATIONS OF THE PHARYNX.

ERYSIPELAS OF THE PHARYNX.—Erysipelas may occur in the pharynx as a primary or a secondary lesion; if the latter, it is an extension of the cutaneous manifestations so common about the head. Cases have been reported in which infection has seemed to come from some distant part of the body. As a primary disease it is comparatively rare, though perhaps some of the milder attacks have not clinically differentiated themselves from other forms of angina, their real nature being overlooked.

Etiology.—"Erysipelas is caused in man," says Kiliani,¹ "by the action of a chain coccus identical with the streptococcus pyogenes, that causes suppuration in various parts of the body, from a simple abscess of the skin to a fatal peritonitis, and which may be the cause of septicæmia without suppuration." The particular micro-organism of the disease is known as the streptococcus erysipelatis of Fehleisen, its discovery dating back to 1882. The most frequent mode of transportation of the virus is by contact, such as from handling either a patient ill from the disease or the bedding and other surroundings which through him have become contaminated.

Pathology.—Three grades of severity of the affection may be distinguished: (1) simple redness of the parts; (2) formation of phlyctenulæ; (3) a continuation of inflammation leading to gangrene. The tissues are swollen and brawny, though there may not be the sharp demarcation of the limit of infiltration one is accustomed to see when the disease is confined to the skin.

Symptoms.—The disease begins with a chill, followed by high fever and its usual accompaniments, together with intense pain and difficulty in swallowing. The swelling of the pharyngeal mucosa is pronounced from the start, though the characteristic efflorescence may be somewhat delayed. The starting-point is generally the lymphoid tissue at the base of the tongue, but extension to the epiglottis and aryepiglottic folds may occur, quickly causing marked dyspnoea. This early extension explains the suddenness with which œdema may threaten life.

Diagnosis.—Notwithstanding the difficulty of an early diagnosis, the prompt recognition of the malady is a matter of the greatest importance. If œdema of the glottis results, the prognosis is generally fatal, in spite of either intubation or tracheotomy. It may be that the serous infiltra-

¹ Twentieth Century Med., vol. xvi. p. 409.

tion of the mucosa and submucous tissues becomes purulent, leading to sepsis, or the larynx may become the seat of suppurative processes, or there may be the usual carbonæmia from laryngeal stenosis. A well-defined margin of infiltration in association with constitutional symptoms would suggest erysipelas, even in the absence of the cutaneous lesions.

Prognosis.—This is always grave, though recoveries have been reported. Delavan¹ has reported the case of a man twenty-nine years of age in whom the disease first appeared on the tonsils, and who later developed cerebral symptoms eventually ending in insanity. The same author quotes statistics of Cornil showing that out of nine instances in which the disease first appeared on the face, and later in the pharynx, seven died, while in nine others in which the pharyngeal exanthema appeared first and was followed by the external invasion, seven recovered.

Treatment.—No better constitutional remedy has ever been found than the muriated tincture of iron, of which thirty minims should be given every three hours; it should be well diluted with glycerin and water. Externally, ice compresses or the Leiter cold-water coil may be applied. Later, resolvents, such as large mustard-plasters, should replace the cold applications. On the inflamed tissues may at first be painted solutions of cocaine or menthol to relieve pain, and later, with a view of controlling the specific process, fifty per cent. ichthyol in glycerin. The rapid progress of the disease in the pharynx, and the fact that the first inspection will probably show the process well advanced, make all applications to limit it of doubtful efficacy. Alcohol and strychnine will be needed to combat depression. Pilocarpine has been suggested as having a beneficial effect on pharyngeal erysipelas, but should be used, if at all, with great caution, owing to its effect on the heart. The antistreptococcus serum has benefited some cases, but entirely failed in many others. Local antiseptics should be enforced. Œdema of the larynx or adjacent parts calls for scarification. In cases of threatening asphyxia the surgeon may intubate or perform tracheotomy, but, as has been said, these cases are fatal, the patients dying of sepsis. Marmorek asserts that he has developed an immunizing serum for the affection.

HERPES OF THE PHARYNX.—This affection consists in the occurrence on the inside of the cheeks, uvula, soft palate, and occasionally on the tongue of small blister-like patches resembling those of cutaneous herpes. Rarely the tonsils and epiglottis are invaded, but the posterior pharyngeal wall generally escapes. The lesion may be unilateral or bilateral, and may occur simultaneously on the genitals, about the nose, and on the lips.

Etiology.—Among the causative factors are exposure to cold or to septic influences, especially bad drainage, menstrual irregularities, and febrile states. It is more common in delicate children and neurotic girls, and is especially prevalent in cold and damp climates and during

¹ Trans. Amer. Laryngol. Assoc., 1885, p. 48.

diphtheria epidemics. Many of the patients are distinctly anæmic; others present gouty or rheumatic tendencies. Some authors place the disease under the heading of pharyngeal neuroses.

Pathology.—The initial stage is characterized by vesicles singly or in patches and distended with serum. This stage is rarely seen, however, for the raised epithelial covering is so fragile that it quickly bursts, leaving either no trace or, at best, a shallow ulcer. Sometimes the patches coalesce, forming a large bulla, which, after evacuation, becomes covered with a membranous deposit. This, however, is easily removed, and may partially detach itself, remaining in the throat like a loose curtain. Bosworth records three cases resembling herpes iris: "small rings of minute papules enclosing a patch of healthy mucous membrane." The process has been regarded as a neuropathic one, some considering it as a herpes zoster of the trifacial nerve. Herzog has suggested as the fundamental cause irritable conditions in the region of the nerve-branch supplying the pharynx and the posterior nasal nerve as well as the Vidian. The theory most commonly accepted is that of a localized inflammation of the papillæ of the subepithelial layer of the mucosa originating in the terminal nerve filaments. Bacteriological investigations have thus far been negative.

Symptoms.—These may be ushered in by severe gastric disturbances, lasting two or three days, or by a pronounced headache. A moderate febrile reaction develops, followed by itching or burning in the fauces, increased by swallowing, and attended by profuse salivation. The local discomfort may radiate to the nose, ears, and sometimes to the larynx. Inspection shows the lesion as above described appearing in several crops, lasting two or three days. When first seen it may be papular or vesicular; later the vesicle contents may become purulent. The sub-maxillary glands are often enlarged; deep ulceration has been noted, and, according to Herzog, even palatal perforation. Following the subsidence of the acute stage the soft palate may be paralyzed, a fact strengthening the neuropathic theory of the disease. Successive crops of eruption may prolong the course of the disease to somewhat over a week. After recovery the pharyngeal mucosa seems to be unusually sensitive to all infectious agents.

Treatment.—Special attention should be paid to the general integrity of the nervous system, as relapses are very common. In distinctly neuropathic subjects excellent results have been obtained with arsenic, which may advantageously be combined with iron and strychnine (arsenous acid, one-twentieth of a grain; strychnine sulphate, one-thirtieth of a grain; powdered iron, two grains; after meals). Cases showing rheumatic tendencies need the salicylates. Tincture of aconite is highly commended by Schech. Locally, sedative and demulcent mouth-washes may be used. Potassium chlorate should not be employed, as it seems distinctly to aggravate the condition. In case the patches show an inclination to spread,

mild caustics may be used. Over the affected areas morphine and carbolic acid or cocaine and menthol, in some bland unguent, may be applied.

PEMPHIGUS OF THE PHARYNX.—The large vesicles characteristic of pemphigus are sometimes seen in the throat; they may be antecedent to the same lesion on the skin or may occur independently. The pharyngeal localization of the disease appears to be very rare in America, but numerous cases have been reported by Continental observers. Concerning the exact nature of the affection opinion is still unsettled, though it is generally regarded as a trophoneurosis. The disease has been observed in the syphilitic dyscrasia and in women suffering from uterine disorders.

The vesicular stage may last only a few hours, being ushered in by a pricking sensation in the throat. The epithelial covering speedily becomes thinned by maceration and bursts, and the resulting erosion may quickly heal or may become coated with a fibrinous layer holding in its meshes mononuclear and polynuclear leucocytes. The eruption does not spread all over the throat, but seems to restrict itself to, and reproduce itself upon, certain selective areas.

Symptoms.—The acute form of the disease is ushered in by fever, nausea, and vomiting. Deglutition becomes difficult and even painful. Speech may be indistinct, and dyspnoea has been observed. In the chronic forms may be noted as diagnostic features¹ clear watery blebs, or membranous patches with regular but well-defined edges on an inflamed base, or red areas free from membrane and looking as if varnished; the intervening mucosa is normal. The conjunctivæ may present a similar lesion. The patients are often debilitated, and the affection is extended over many years. Avellis² has seen one case of adhesion of the soft palate to the posterior pharyngeal wall resulting from pemphigus, and alludes to three others.

Treatment.—The sheet-anchor is arsenic given internally up to full physiological tolerance; no other drug seems to have the least specific effect. Debilitated states and the presence of any dyscrasia suggest their own remedies. It may not be amiss to refer here to a case of pemphigus-like eruption which followed the use of antipyrin, reported by G. Lyon.³ In this instance both the skin and the pharyngeal mucosa were affected. Finally, in speaking of throat eruptions, it must be remembered that this area may present many varieties of toxic erythemata coming from a disordered stomach and bowels. Full purgation will cause all of these quickly to disappear.

DIABETIC ULCERATIONS OF THE PHARYNX.—Joal, in 1882, was the first to call attention to the peculiar appearance of the pharynx in

¹ Menzel, cf. *Laryngoscope*, vol. vii. p. 63.

² *Münch. Med. Woch.*, March 6, 1900.

³ Cf. *Centralb. f. Lar.*, 1898, Bd. xiv. S. 85.

diabetes, though, in an indefinite way, in this disease dryness of the parts has long been recognized. The subject has also been studied by various authors since that time. Garel¹ distinguishes two stages of the condition, one of hyperæmia and the other of anæmia, regarding both as parts of the same process. He does not consider the atrophic form as different in appearance from the atrophy seen in many other systemic or local conditions, but the hyperæmic form presents characteristic clinical features, and is of special import from its early appearance and prognostic significance. The notable features are pharyngeal dysæsthesia, difficulty in swallowing the saliva, swelling of the pharyngeal mucosa, and exaggeration of the pharyngeal reflexes. The foregoing are not absolutely diagnostic of diabetes, for some of Garel's patients showed albumin but no sugar. In fact, out of twenty-one only ten had sugar, while eleven had albumin. The main lesson to be learned from such experience, and one upon which Garel strongly insists, is the necessity of examining the urine of every patient, not alone in hospital but also in private practice. Many obscure cases may thus be unravelled.

W. Freudenthal² has reported a series of cases presenting pharyngeal ulcerations due, he thinks, to diabetes. He has seen three instances of ulceration occurring in diabetes of a milder type, two of which involved the larynx. In one of the latter great relief and finally healing resulted from the use of orthoform.

¹ Ann. des Mal. de l'Oreille, February, 1895.

² Laryngoscope, February, 1900, p. 92.

though some of the cases reported under this heading have not been true papillomata, but rather lympho- or fibro-angiomata. Both have a covering of stratified epithelium, but differ in their stroma. In the former the bulk of the growth consists of pure lymphoid tissue, while in the latter this tissue is interspersed with fibrous bundles. Wyatt Wingrave¹ observes that the true papillomata generally grow from the surface of the organ, while the so-called polypi (sometimes mistaken for the former) spring from the interior of the lacunæ.

As will be noticed by referring to Schmidt's figures, fibromata are far less common, and his experience coincides with that of other clinicians. These tumors are of slow growth and hard consistency. Several varieties of mixed tumors, such as fibro-enchondroma, fibrolymphadenoma, etc., have been seen in the pharynx.

During the last few years several cases of lipomata and fibrolipomata have been recorded. All of the foregoing were confined to the tonsil. Ripault² has seen a fibrolipoma of the soft palate which seemed to have separated the anterior and posterior surfaces of that structure. It was dissected out, the mucosa trimmed, and the two surfaces of the velum united by a row of sutures extending across the throat. A hæmatoma followed this operation, but eventual recovery without recurrence is recorded. Avellis³ reports the case of a pedicled lipoma of the tonsil in a boy of twenty, containing, as most of these growths in this situation do, a delicate connective-tissue framework. He suggests the theory that certain fat-cells of the embryonic state become dispersed, lodging in the tonsil, and that later the lessened resisting power of neighboring cells allows of their over-development and the formation of a tumor. This seems a reasonable supposition, for no fat-cells normally enter into the formation of tonsillar tissue.

Angiomata are rare. Four cases are reported by Bosworth, in one of which (that of W. C. Phillips) the large vessels extended from the uvula over the soft palate, causing a difficulty in swallowing sufficient seriously to interfere with nutrition. Another case has been seen by Magnan.⁴ T. R. Chambers⁵ reported the case of a boy sixteen years old who, probably as the result of trauma, showed a bluish tumor on the anterior aspect of the left posterior faucial pillar. J. Wright⁶ has seen one in the middle of the lingual tonsil. In all of these cases of angiomata forcible inspiration will often greatly diminish the size of the mass.

Adenomata of the palate are not uncommon, there being quite a large list on record. Most of them have occurred in patients between the ages of

¹ Jour. Laryngol., 1898, vol. xiii. p. 132.

² Ann. des Mal. de l'Oreille, 1898, vol. xxiv. p. 457.

³ Arch. f. Lar., Bd. viii. S. 560.

⁴ Jour. de Méd. de Bordeaux, February 22, 1896.

⁵ Cf. Laryngoscope, 1900, vol. viii. p. 237.

⁶ Laryngoscope, 1897, vol. ii. p. 190.

twenty and fifty. Statistics show them to be twice as common in women as in men. The writer has seen one case of fibro-adenoma in a man aged sixty, involving the left anterior portion of the soft palate and sending a prolongation backward and upward behind the ascending ramus of the inferior maxilla, complete removal being somewhat difficult. These tumors are usually sessile and of slow growth, and do not, as a rule, form any adhesions with surrounding parts. They are often mistaken for fibromata, but the latter grow more rapidly, are more apt to be painful, and cause more disturbance by their mechanical pressure. According to Schech, adenomata are always situated on one side of the middle line of the anterior surface of the soft palate, and are developed from the submucous glands. Their surface is slightly smooth or mammillated, and their size varies from that of a hazel-nut to that of a hen's egg. The glandular acini may become so dilated as to form small cysts in the bulk of the tumor. The connective-tissue elements of the growth may be arranged near its surface in such a way as to form a sort of capsule, thus rendering enucleation easy.

Tumors of the oropharynx are rare. Bosworth reports seven cases of fibroma and two of dermoid growths. Avellis¹ saw a child a few hours after birth in whom there was a polyp of the left pharyngeal wall, causing imminent danger of asphyxia. The mass seemed to lie on the base of the tongue. The uvula was wanting, the posterior segments of the soft palate having failed to unite. The growth was as large as the phalanx of the thumb of an adult, and by palpation could be traced to the general region of the left tonsil. It was drawn forward with forceps and removed with a galvano-cautery, with instant relief from the threatening symptoms. Examination of the tumor showed it to be a teratoma. A complete bibliography of the literature of these rare growths was given by Conitzer² in 1892. Mention may be made of a case of molluscum pendulum of the tonsil reported by Furet³ as occurring in a male adult, probably the only case of the kind on record.

Cysts of the tonsils have been seen by various writers, who agree in the general statement that the contents are thick creamy mucus and epithelial cells. Sometimes they seem to project from the surface of the tonsil, while at others the mucosa shows at a certain point only a bluish discoloration, a portion of the thin cyst-wall showing a fine vascular network.

The symptoms of all the foregoing are referable to their size, shape, and situation. Many of the papillomata are so small that their presence is never noted by the patient, and they come to light only when a systematic examination of the throat is made by a physician. After the

¹ *Rev. Int. de Rhinol.*, 1893, No. 10, p. 219.

² *Deut. Med. Woch.*, 1892, No. 51.

³ *Arch. Int. de Laryngol.*, 1897, No. 4, p. 473.

neoplasm has attained a certain size there may be indistinct speech, difficulty in swallowing, and the constant feeling as of a foreign body. If the growths become pedicled, they may be caught in the teeth and be accidentally bitten off, or they may fall backward and irritate the glottis, thus causing cough and even dyspnoea. Adenopathy is absent.

The treatment of all is purely a matter of surgery. Some of the smaller ones can readily be snipped or snared off. It is a good plan to remove a little of the mucous and submucous tissue surrounding the base of the growth in order to prevent recurrence. Sessile growths require some form of *écraseur*. For angiomata the ideal method of removal is by the galvano-cautery snare; but care must be taken to have this engage at the base of the growth, as section at a higher plane is apt, in spite of all precautions, to be followed by severe bleeding. With some of the larger growths an extensive dissection may be necessary to insure complete eradication.

B. MALIGNANT GROWTHS.—Practically, all the malignant growths in the region under consideration may be classified as either lymphoma, sarcoma, or carcinoma.

Primary malignant lymphoma is of very rare occurrence in the pharynx. According to Honsell¹ and Jardon,² but seven cases have been recorded. Mamlok has published the history of another,³ occurring in a man aged sixty years. The case was regarded as inoperable, but temporary improvement took place under the use of iodine externally and arsenic internally.

The diagnosis of these growths lies between lymphoma, sarcoma, and leukaemia. In leukaemia there are the characteristic blood-changes, especially the increase of white cells and a marked condition of debility. In lymphoma the blood is normal, and in spite of these sometimes enormous tumors the patients remain for a long time in fairly good general condition. Sarcoma is of more rapid growth and develops its own cachexia. Objectively, the two (sarcoma and lymphoma) present great similarity in their early stages, but examinations of sections of typical specimens from them will show a marked difference. Malignant lymphomata are true hyperplasiae of the lymph-glands. The overgrowth of lymphatic elements may attack a group of glands suddenly, but remains strictly confined to the territory of these glands, so that the capsule is not broken through and the neighborhood of the group is not encroached upon. The extension of the growth follows the course of the lymph-stream, one gland after another becoming involved in the same chain. Microscopical examination shows an increase in the amount of connective-tissue framework as well as a great increase in the lymphoid elements, and the dis-

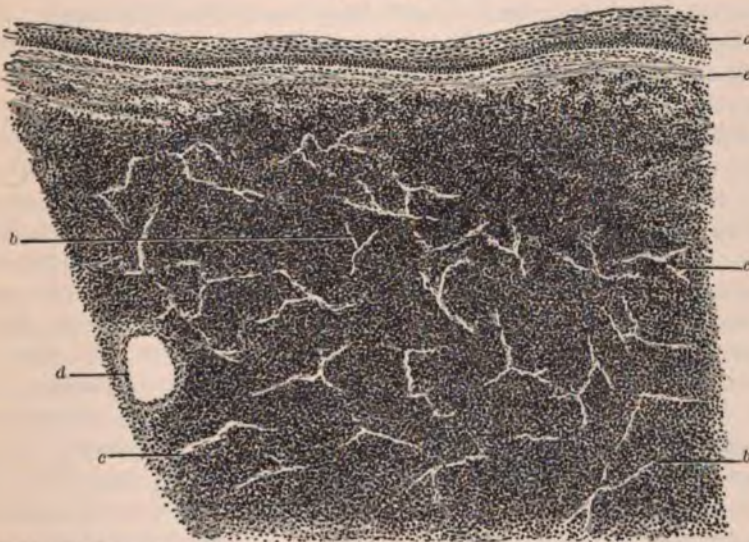
¹ Beiträge zur Klin. Chirurg., Bd. xiv.

² Bonner, Inaug. Dissert., 1888.

³ Arch. f. Laryngol., 1899, Bd. ix, S. 485.

inction between cortex and medullary substance is no longer possible. Finally, the trabeculae become obliterated, owing to the colossal increase of lymph elements, which completely fill the capsule. Sarcoma of the lymph-glands is made up of a heterologous structure, the specific products being round and spindle-shaped cells. These have a tendency to break through the glandular capsule and to attack first the periglandular tissues, and later those more remote, including muscle, fascia, and skin. The tumor quickly becomes adherent to neighboring organs, and is more painful than lymphoma. Mixed forms occasionally occur. The symp-

FIG. 194.



Lymphosarcoma of tonsil. (Seifert and Kahn.) *a*, epithelial covering; *b, b*, traces of follicles; *c, c*, spaces containing delicate fibrous tissue; *d*, dilated vessel; *e*, layer of apparently normal tissue.

toms of the latter are mainly mechanical, and consist of gradual impairment of all the palatal functions. Growth downward affects the physiological integrity of the larynx.

The only remedies which seem to have any effect on the lymphomata are iodine and arsenic. Iodine may be applied locally or may be injected in the form of the tincture directly into the mass. Injections of arsenic have been made in connection with its internal administration. The remedy should be given in small doses, gradually increased to the full physiological effect and then gradually decreased. The choice of preparation seems immaterial. The question is merely as to what form of arsenic will be most easily borne by the stomach in each case.

Sarcomata may involve either the soft palate or the tonsils and pharynx. Of the former, Bosworth has reported some twenty cases, and others are being published from time to time. They seem to manifest

themselves here at an earlier age than when occurring elsewhere in the pharynx proper. They are much more frequent in the male sex, a fact for which no satisfactory explanation has yet been given. No special age seems to be susceptible, about as many cases occurring before as after the fortieth year. All histological forms of sarcoma have been observed. As a rule, growth is slow. Symptoms first show themselves as impairment of vocal function and dysphagia. Unless early ulceration occurs, pain is not a prominent feature; when it does occur, it may radiate to the ear. In some instances the growth has seemed to start from the posterior surface of the soft palate, and finally has overhung the larynx and caused suffocative attacks. Pharyngeal mucus is increased, and there sets in from the ulcerated surface, if such be present, a foul discharge. Bleeding is not common. Eliot¹ reports one case of fatal hemorrhage, the growth being of the spindle-celled variety, occurring in a girl aged twenty-three years. As a rule, adenopathy does not take place until the tumor has definitely invaded neighboring structures. For years it may appear as a smooth, circumscribed mass, slowly increasing in size, with at times long periods of quiescence. Although in general appearance diagnosis from fibroma is impossible, the surgeon is assisted by the fact of the rarity of fibroma at this site and by the absence of pain in the latter.

In a case of suspected sarcoma of the palate, potassium iodide should be given to exclude the possibility of a gummy tumor. In the light of modern surgery much is to be expected from early or even late intervention, for sarcoma of the palate does not seem to be especially malignant, at least so far as concerns rapidity of growth. This favoring circumstance has been ascribed to the scantiness of lymphatic channels. As to details of removal, each case must be attacked along the lines it suggests, care being taken to encroach slightly upon surrounding healthy areas in order to make removal thorough and lessen the chances of recurrence. In certain cases, where the extent of the growth makes operative intervention inadvisable, good results—even entire removal—have followed the injection of a combination of the toxins of the bacilli of erysipelas and of *B. prodigiosus*, according to the plan developed by W. B. Coley and others. Only the spindle-celled variety, however, seems to be affected favorably by this treatment. A notable success was reported some time ago by W. B. Johnson;² but other observers, following identically the same treatment, have reported complete failure. The plan is, however, worthy of trial. For the discharge, hydrogen dioxide followed by an alkaline antiseptic mouth-wash may be used. Hopeless cases call for opium to relieve pain.

Symptoms of sarcoma of the tonsil may be referred to mechanical disturbance or may be ushered in by the features of a common angina.

¹ *Illus. Med. and Surgery*, 1882, vols. i. and ii. p. 107.

² *New York Med. Rec.*, November 17, 1894, p. 616.

The acute stage of the latter subsides, but the region of the affected tonsil is left tender, while the swelling persists and gradually encroaches upon the surrounding parts. Ulceration comes on relatively early, and hemorrhage is more common than where the growth is limited to the palate. The ulceration is accompanied by the usual offensive discharge, and glandular involvement soon becomes manifest. In one or two instances the deeper parts of the growth suppurated, the escape of pus temporarily abating the severity of the local symptoms. The general health deteriorates, and the cachexia of malignant disease soon comes on. Few cases live more than a year.

The question of diagnosis depends upon the results of microscopical examination and the effects of the iodides. Treatment should be as indicated above, and, if possible, complete eradication should be undertaken. At times it is necessary to attack the growth from the outside, completely extirpating the cervical glands; bacteriotherapy may also be tried. Chamberlain¹ reports a case of round-celled sarcoma of the tonsil in a man twenty-six years of age. Excision was performed, but a rapid recurrence led him to try injections of toxins as above outlined. The result, though distinctly favorable, was, at the time the case was reported, not decisive.

Reported cases of sarcoma of the oropharynx number about thirty. In this situation the growth may be pedunculated or have a base of moderate size. The higher up in the pharynx the slower the growth, as a rule, and the less the tendency to glandular involvement. It is usually of the spindle-celled variety, and occurs more often in males after middle life. Symptoms are referable to obstruction of the pharynx, causing difficulty in breathing and swallowing. The prognosis is bad. If the base is small and accessible, removal may be attempted with the galvanocautery snare; but if it be broad and low down, it is better to gain access to it by a lateral or subhyoid pharyngotomy.

Carcinoma of the soft palate is uncommon. Bosworth (1892) enumerated thirty cases. The disease is more common in the later years of life, and almost without exception has occurred in men. The cancerous growth shows a tendency here to confine itself to the palatal structures; it probably originates in the epithelium lining the muciparous follicles. Irregular infiltration takes place into the surrounding structures, and ulceration is an early feature. When extension occurs, it is more commonly in the course of the faucial pillars.

Concerning the primary origin of cancer we have no definite knowledge. Modern investigations tend towards the parasitic theory, but whether the parasite is an animal or a vegetable organism is in dispute.

Early symptoms are a loss of flexibility in the movements of the palatal muscles and a consequent impairment of the functions of swallow-

¹ Virginia Med. Month., June, 1895.

ing and speech. Pain may not be severe at the outset, as the soft, yielding palate allows of considerable pressure before the patient begins to suffer. Later appear the ulceration, foul discharge, and cachexia. Hemorrhage from carcinoma confined to the soft palate is not common, and glandular enlargement may be absent until a late period of the disease. Dyspnoea is occasionally present, owing to the backward pressure of the growth, and tracheotomy may be required.

In the absence of microscopical examination a diagnosis in the early stages between sarcoma and carcinoma is not always easy. In the former a circumscribed mass, slowly spreading, of soft consistency, and rarely ulcerating, should be looked for. Opposite conditions will suggest the latter. As to adenopathy, it will be noticed that in both sarcoma and carcinoma this may or may not come on early, according to the confinement of the tumor to the palate. In carcinoma the extension of the growth is, unfortunately, rapid.

Patients always die from this affection, though operative intervention may prolong life and render it more comfortable. Otherwise, the resources are limited to keeping the parts clean by the use of deodorizing antiseptics and to keeping pain under control by local or systemic anodynes. Comfort in taking food may be obtained by the use of cocaine and the coating of the parts with orthoform in emulsion or mucilaginous suspension. In carcinoma bacteriotherapy has not yielded the same good results as in sarcoma.

Carcinoma of the tonsil occurs more frequently than sarcoma of the same organ. Here are found the squamous, alveolar, and columnar epithelial varieties, and also the ordinary stratified epithelioma in which the actively proliferating surface epithelium invades the underlying structures in the shape of cylindrical masses. A second variety tends to spread superficially, so that the cylindrical projections are very short. This form is often mistaken for leucoplakia. Price Brown regards this variety as due to fatty degeneration of the surface epithelium, stating that, if the patch is not removed, desquamation may set in, with the final result of malignancy. This kind of patch is, however, more apt to invade the faucial pillars than the tonsil proper. In a third variety there is a tendency of the epithelium to invade the deeper structures individually. The alveolar form resembles the ordinary scirrhus, except that the stroma is less dense and the alveoli are larger. Lennox Browne has seen only one case of the columnar form, and in this case the cells grew inward and were arranged as single and double layers, appearing as irregular cylindrical tubes embedded in small-celled infiltration tissue.

The symptoms are the usual ones of a malignant tumor in this situation, and have been sufficiently described. Differential diagnosis is possible only by the use of the microscope, as the gross appearances do not always enable one to determine between sarcoma and carcinoma. The former more commonly has a smooth, while the latter may have a fun-

gating surface. Prognosis and treatment are the same as for carcinoma of the soft palate.

Carcinoma of the oropharynx is very rare. Bosworth collated thirty-three cases, but in some the data given do not determine whether or not the growth started in the oropharynx proper. About two-thirds of the cases reported were women, and, somewhat curiously, the disease at this site develops relatively early in life. Local and general symptoms are as already described. The cervical glands are quickly enlarged. Death generally results in from sixteen to eighteen months. Prognosis and treatment are as above outlined. Owing to early interference with deglutition, feeding becomes an embarrassing question, and nutritive enemata may be necessary. Interference with respiration may require an early tracheotomy.

man who for two years had produced an objective noise whenever he turned or bent the cervical spine. Examination showed rhythmical contractions of the palate, varying in rapidity from 90 to 105 per minute. The noises were audible both to the patient himself and to a by-stander, and sounded like the grinding of teeth. Ostino¹ reports the case of a physician who from his fourteenth year had suffered from a subjective ticking sound, which could momentarily be arrested by a voluntary effort, and was not especially troublesome, except at night. The velum was found to move synchronously with the pulse, and an observer could hear a distinct sound, though standing some two feet from the patient's right ear. On the left side the sound was audible only on close contact with the patient; it continued during the movements of mastication and deglutition, but ceased when the tongue was depressed and the floor of the mouth fixed. These sounds are apparently due to the action of the levator palati muscle, and the exciting cause may be either changes in the region of the Eustachian tube or of a reflex nature. In reported cases, removal of lymphoid hypertrophy from the pharyngeal vault, cauterizations of the turbinates, etc., have all been followed by relief.

It is often difficult to assign a cause for some of these cases. In that of Ostino, mentioned above, the sounds and movements temporarily disappeared during an acute coryza, because the congestion of the mucosa of the entire region impeded the action of the palatal muscles. The same physical condition resulted when the depression and fixation of the floor of the mouth antagonized their action. Similar palatal perversity is sometimes seen in the later stages of paralysis agitans.

Muscular spasm in this region is not always confined to the palatal structures, but may extend to the constrictors of the pharynx and even to the upper part of the œsophagus. In these latter cases the nervous implication is prominent, and treatment should be directed in accordance with this fact.

The most important motor neurosis is paralysis. The chief causes of this are diphtheria, degeneration of the medullary nuclei, pressure on the medullary nerves, or tumors pressing on the base of the brain. Loss of motion may be attended by partial or complete loss of sensation, as in ordinary cases of hemiplegia. Local inflammations may cause a serous infiltration of the muscular substance, resulting in a loss of power, though not a true paralysis; so, also, varying conditions of neuritis may be induced by different toxins.

Lecocq has given the histories of two young women with nasal voices and dysphagia, in whom there had been no antecedent diphtheria or inflammatory condition. An affection of the facial nerve was considered impossible, owing to the absence of facial paralysis. (This view is, however, erroneous, as the palate is supplied by the vagospinal trunk, not

¹ Arch. Ital. di Otol., 1900, vol. x. p. 26.

the facial, p. 466.) No mesophalic or bulbar lesion could be determined. Lecocq called the condition "essential paralysis," due to neuritis starting in the nerve-fibrillæ themselves, without extension from any neighboring organ. Medication and the continuous current were without effect, while the interrupted current led to a surprisingly quick recovery.

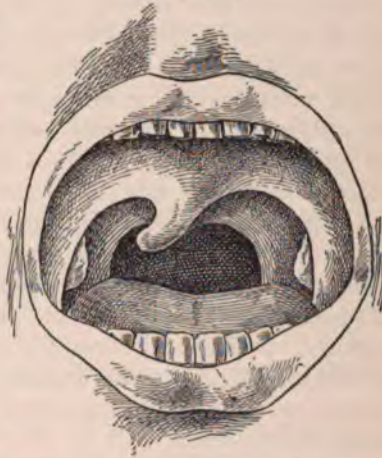
In all these conditions of paralysis the palate is more or less flaccid, and is not completely raised in either phonation or deglutition. In unilateral paralysis the arch of the fauces is distorted, being abnormally roomy on the affected side, and during phonation there is a distortion of the whole structure towards the sound side. In bilateral paralysis the uvula and the whole palate hang loosely, and move feebly or not at all, according to the degree of the paralysis. The simplest test of motility is to have the patient utter a sound of high pitch. In normal conditions the levators act strongly. Reflex stimulation with the probe or a weak electric current will also determine the amount of loss of muscular power. In all of these states the vowel sounds have a twang which only the "n" and "ng" sounds should have; also the failure to shut off the nasopharynx in forcing air through the mouth to pronounce "p" and "b" makes of these respectively "f" and "v." In swallowing, the muscles of deglutition sometimes lose control of the ingesta, which consequently pass into the nasopharynx and cause choking.

In cases of loss of power of one vocal cord the palate is apt to be affected on the same side, and occasionally there is loss of power on the same side of the tongue, with more or less atrophy. This symptom-complex is referable to lesions of the anterior part of the medulla. As the tongue and cord lesions are manifestly due to lesions of the hypoglossal and higher fibres of the spinal accessory nerves, Hughlings Jackson, who first pointed out the association of these three paralyses, was led to believe that the palate received its innervation from one of these sources, a theory which has been fully confirmed by later anatomical studies.

Paralysis of the constrictors of the pharynx is generally due to either diphtheria or bulbar lesions. Here the immediate danger is that of suffocation from the passage of ingesta into the air-tube.

All the foregoing conditions of paralysis call for the exhibition of iron, arsenic, phosphorus, and especially strychnine, together with the

FIG. 195.



Paralysis of left side of palate. (Bosworth.)

employment of the faradic or galvanic current, according to electrical reaction. Many of them are due to incurable lesions of some portion of the nerve-axis, and such patients should be made comfortable and, if necessary, fed through a tube. Cases referable to diphtheritic neuritis generally recover of themselves, but much can be done to hasten this result. The constant current is generally more serviceable than the interrupted; the positive electrode should be placed over the cervical vertebrae, while the negative may be applied directly to the affected muscles.

VASCULAR NEUROSES.—A word may be added concerning vasomotor disturbances in this region. These generally take the form of what has been called by Strübing "angioneurotic oedema." It is a vasomotor disorder, characterized by an abrupt oedematous swelling of variable extent, occurring sometimes with gastro-intestinal crises. There seems to be a marked hereditary element in the affection, and a periodicity in the attacks is often noted. Death may occur from oedema of the larynx. Thomas Hubbard¹ reports the case of a woman thirty years of age, with attacks of faucial oedema which seemed to be the expression of a cumulative autotoxæmia. The patient was subject to peritonsillar swellings, which would come on suddenly and during their continuance prevent deglutition. They occurred twice a month for a period of two years; the patient would be confined to bed for a couple of days, and the attack would then pass off. Starvation seemed to be the best treatment, and eliminative measures finally broke up the series of attacks. Patients who suffer in this way are usually of the lithæmic type. These affections have sometimes been called giant urticaria, but Hubbard notes as differential points that in angioneurotic oedema there is a definitely localized, persistent vasomotor instability, while in urticaria the area of attack is shifting, the attacks intermittent, and there seems to be a vasomotor irritability responding to certain irritants, probably from the gastro-enteric tract.

¹ Ann. Otol., Laryngol., and Rhinol., November, 1897, p. 425.

CHAPTER X.

DISEASES OF THE UVULA AND TONSILS.

MALFORMATIONS AND ANOMALIES.—In three thousand cases of throat diseases seen in routine practice, C. Berens¹ found eighty-four of abnormalities. Typical instances of double uvula have been reported by Somers² and others. Lennox Browne³ reports a case of double, and says that he has seen one of triple, uvula,—a central and functionally efficient one, with on each side a shorter prolongation not containing muscular fibres.

Farlow has called attention to a condition of the uvula often mistaken for relaxation,—namely, an uneven or irregular development of the azygos uvulæ muscle. The organ hangs towards the side of the greater amount of muscular structure, simulating a paretic state. Watson records a case of varicose veins of the uvula and soft palate, the former being nearly two inches long and made up of venous knots. Cohen has seen the enclosure of a uvula of considerable size in a fold of mucosa which was continuous with the anterior faucial pillar, extending horizontally from one tonsil to the other. Minor degrees of this latter anomaly are not uncommon. One case of cleft tongue with complete absence of the soft palate, occurring in a child seen at the eighth month, has been recorded by Helsham. Somers has called attention to uvular defects as stigmata of degeneration, quoting C. L. Dana as having found defects in either shape or innervation in very nearly fifty per cent. of all cases of degeneracy examined.

SPONTANEOUS HÆMATOMA.—As a result of trauma, especially that due to operative intervention, hemorrhages into the substance of the uvula are not uncommon, but spontaneous hemorrhage is very rare. One case has been reported by Ripault⁴ in a man aged sixty years, in whom the condition came on suddenly during the night, causing him much discomfort. Varicose enlargements were visible on the faucial pillars, while the vascular system presented uniform evidences of arteriosclerosis. The swelling was presumably the result of rupture of a small vessel in the substance of the uvula. The obvious treatment in such a case is carefully to examine the condition of the vessels and to test the urine. A case of *calculus* of the uvula has been reported by Goodale.⁵

¹ Phila. Med. Bulletin, May, 1893.

² New York Med. Jour., March 10, 1900, p. 341.

³ Throat and Nose (ed. 1899), p. 320.

⁴ Ann. des Mal. de l'Oreille, 1898, vol. xxiv. p. 463.

⁵ Boston Med. and Surg. Jour., December 8, 1898, p. 571.

ACUTE UVULITIS.—Acute uvulitis rarely occurs alone, but is generally one feature of a composite process which affects the fauces and pharynx. The mucosa at the tip of the organ is somewhat thicker and less compact than elsewhere in the mouth, and this condition favors exudation, which is apt to assume the œdematous type.

Etiology.—The affection generally results from trauma due to misdirected operative intervention in the neighborhood, especially as a part of the reaction following operations on the tonsil, notably ignipuncture, even in cases in which the uvula itself has in nowise been injured. It may also arise from the ingestion of irritating food, from prolonged and excessive vocal effort, and from various forms of sepsis.

Pathology.—The uvula becomes swollen and œdematous, and may, from the rupture of superficial capillaries, even bleed. Acute œdema is not infrequently seen in the later stages of phthisis and syphilis, and the organ may share in the more chronic hydræmia of various visceral affections. An arthritic diathesis seems to predispose to inflammations of the uvula.

Symptoms.—These are of the general sore throat variety, constitutional symptoms being of a mild type or altogether absent. The local discomfort varies from a slight impediment to respiration and the feeling as of a mass in the fauces up to a pain of considerable severity. The voice has a muffled sound, and if the organ is long enough to reach the epiglottis there are added a muffled cough and possibly slight dyspnoea.

Treatment.—In the milder cases, purgation by a mercurial, followed by a saline, together with the use of some simple astringent mouth-wash, will relieve the condition. Hot alkaline gargles are grateful during the acute stage. It is not recommended to remove at this time an undue length of the organ, but if the œdema is excessive it is proper to puncture or scarify and use antiseptic washes. It is scarcely necessary to say that the knife employed should be most carefully sterilized and have a fine point; it is well also to hold the organ with a fine-toothed forceps or by means of a small spoon passed behind it, otherwise it is apt to slip away from the sharpest point. Suppuration of the uvula is rare. L. Vervaeck¹ has noticed in recent pandemics of the grippe many cases in which the throat lesions seemed confined to the uvula, which was swollen and œdematous. A special feature was a submucous hemorrhage coming on during the period of convalescence.

CHRONIC UVULITIS; HYPERTROPHIED UVULA.—Simple chronic uvulitis is merely one element in the general condition of chronic inflammation of the entire faucial tract. Very few patients pass through a siege of chronic sore throat without the sequel of a more or less enlarged uvula. Vocal use during a period of acute inflammation is apt to lay the foundation for its development, and it is especially associated with

¹ Jour. de Méd., 1899, No. 14.

chronic gastric disturbances. Other causes are the same as those inducing acute inflammation.

Pathology.—Lennox Browne notes four varieties of change,—fibroid, mucoid, vascular, and glandular. Bearing in mind the structure of the organ, it is easy to see how the mucosa may prolapse on the underlying muscular cylinder and present itself as a pointed tip of a pearly white color and an œdematous consistency. Sometimes the muscular cylinder itself is hypertrophied, but the enlargement usually consists of an increase in the bulk of the organ rather than a simple elongation. In some cases of the latter class the organ is so long that it reaches the dental arcade in front and the entrance of the larynx behind.

In this condition the striated muscular fibres undergo degeneration, showing, according to Hoen,¹ marked proliferation of their nuclei and, in the later stages, a disappearance of the contractile substance to a greater or less degree. The veins are enlarged, the arteries are diminished in size, and the surface epithelium is thickened. Rarely the glandular hypertrophy forms the bulk of the organ, and groups of leucocytes beneath the surface suggest recent inflammatory changes.

Symptoms.—These are of all grades of severity, and do not necessarily correspond with the size of the uvula. Some patients with enlarged uvula present no symptoms at all, but the majority complain of tickling, hacking cough, retching on slight provocation, and occasional vomiting. As special excitants of these outbreaks may be mentioned sudden changes of temperature (even the cold bath) and fatigue. Sometimes during sleep the faucial relaxation brings the tip of the organ in contact with the entrance to the larynx, and the patient wakes with a sudden laryngeal spasm. The constant cough may cause rupture of some of the superficial vessels either of the uvula itself or of the surrounding structures, and tends still further to elongate the organ. The appearance of blood-streaks in the expectoration and the exhaustion attendant on coughing often lead to a suspicion of pulmonary disease, especially as the condition is accompanied by considerable debility, patients often losing much flesh and strength from this trivial ailment. As a result of hypertrophied uvula and consequent impaired action of surrounding muscles, singers experience a loss of vocal range, early fatigue, and sometimes an annoying tremolo upon the attempted production of any forced tone.

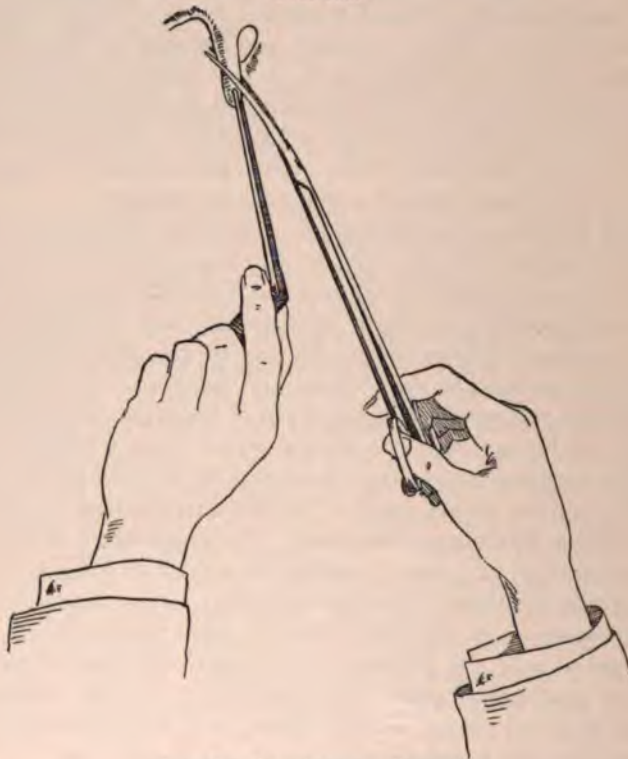
Treatment.—Any associated catarrhal state should be treated as for an acute condition, and, if necessary, a portion of the uvula removed. This operation has often been abused in the past, but recently there has been a reaction against over-zealous surgical procedures. Astringents may profitably precede surgical intervention, but their effects in pronounced cases will be but temporary, and on their cessation the old train

¹ Jour. Exp. Med., vol. iii. p. 551.

of symptoms will reappear. Mild cases of elongation may permanently disappear if the stomach be regulated.

From a surgical point of view the main question is, Granted that uvulotomy is necessary, how much of the organ should be removed? In the adult the uvula measures, on the average, three-eighths of an inch in length, and, with the mouth closed, should hang free in the fauces, not touching the tongue. Before making an estimate of the amount of tissue to be removed it is essential that the part be at rest in a normal position, otherwise the soft palate will be raised and the uvula along with it, thereby distorting natural relations.

FIG. 196.

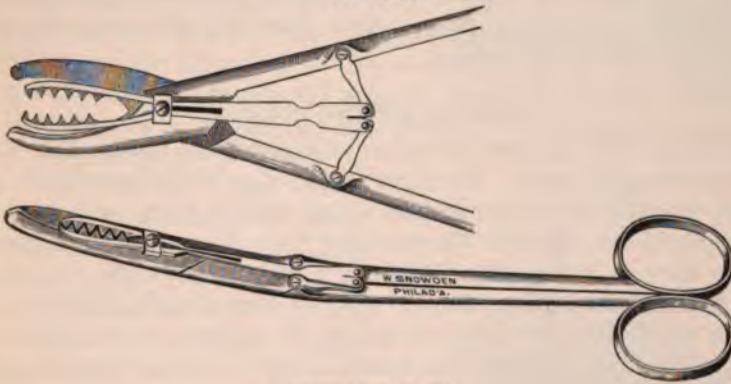


Operation of uvulotomy. (Bosworth.)

The operation of uvulotomy or staphylotomy is often performed by the general practitioner, and hence is here described in detail. Anæsthesia is easily obtained with a ten per cent. cocaine solution, applied in spray or on a cotton carrier. The tongue is depressed with an instrument (preferably Türek's) held by the patient (Fig. 174), the tip of the organ is drawn forward with a pair of fine-toothed forceps, and the section made either with one of the uvulotomes in common use or with a pair of long-handled scissors curved on the flat side.

Care should be taken to make the section in such a way as to bevel the organ on its posterior surface. Food is thus prevented from coming in contact with the raw surface, and the drip of the secretions from above is facilitated. Pieces of ice held in the mouth lessen the after-smarting.

FIG. 197.



Sajous's uvulotome.

The uvula will contract somewhat after section, and this fact must be taken into account in estimating the amount of tissue to be removed. The latter, at times, consists mainly of thickened mucosa, but there may be cases in which it is advisable to remove a portion of the muscular

FIG. 198.



Seller's uvula scissors.

cylinder. Bleeding is but slight, and generally ceases on the use of the familiar gargle of gallic and tannic acids (gallic acid, 1 part; tannic acid, 3 parts; water, 4 parts; which on being shaken makes a viscid mixture, and should be held in the mouth without dilution or should be sipped). The shorter the stump the more likely is bleeding to occur. For an exhaustive review of the literature of this complication the reader is referred to an article by the late E. C. Morgan.¹

De Blois advocates for this operation the use of the galvano-cautery.²

¹ Trans. Amer. Laryngol. Assoc., 1886, p. 80.

² Ibid., 1893, p. 108.

He employs a fixed loop, purposely avoiding one which can gradually be tightened, and which will not leave a straight surface and continuous bevel. As soon as the cautery is felt on the posterior surface of the uvula it is drawn tight by the reflex action of the palatal muscles, and by traction with forceps in the opposite direction the operator can bevel the cut very easily, so that when the wound has healed the stump will retain the normal tapering shape rather than the bulbous end frequently left after the use of the scissors.

DISEASES OF THE TONSILS.

Anatomy.—The general situation of the faucial tonsils has already been mentioned (p. 463). The most logical view of the association of the various tonsillar structures is that which regards them as localized enlargements in the course of the so-called "tonsillar ring" of Waldeyer.¹ By this term is meant that irregular circular continuity of lymphoid tissue which starts in the nasopharynx and stretches on each side to the edges of the Eustachian tubes, thence to the posterior surface of the soft palate, to the space between the faucial pillars (forming here the faucial tonsils), and finally unites in the fourth or lingual tonsil, which lies on the floor of the tongue between the circumvallate papillæ and the epiglottis. Similar deposits are found in the ventricle of the larynx and in the nasal mucosa.

The faucial or palatal enlargements of the ring average from twenty to twenty-five millimetres in height and fifteen millimetres in breadth. They are irregularly oval in shape, limited above by the approximation of the faucial pillars, but extend a variable distance below. They correspond to the anterior portion of what is called the "pharyngomaxillary interspace,"—that is, the space between the lateral pharyngeal wall, the internal pterygoid plate, and the upper cervical vertebræ, lying almost directly back of the pharyngopalatine arch. This interspace is filled with connective tissue. Under normal circumstances the tonsils do not protrude beyond the plane of the faucial pillars; free on their inner side, they are in relation on their outer with the amygdaloglossus and styloglossus muscles and a few fibres of the posterior pillar. According to F. C. Cobb,² outside of these few small fibres a hard fibrous wall about one millimetre in thickness is found, from which septa run into the tonsil, this wall forming its capsule. Continuing from within outward, the superior pharyngeal constrictor and the buccopharyngeal fascia are successively met. This fascia forms the inner wall of the pharyngomaxillary space. In the posterior part of the latter are the large vessels, and corresponding to its anterior part are the tonsils. These relations are of interest as bearing on the position of the carotid arteries, which are a

¹ Deut. Med. Woch., No. 20, 1884.

² Boston Med. and Surg. Jour., July 27, 1899.

definite distance outward from the vertical plane of the tonsils as well as behind them, the distance from the lateral periphery of the tonsil being for the internal carotid one and a half centimetres and for the external two centimetres.

Supratonsillar Fossa.—Considerable has been written of late years concerning the so-called supratonsillar fossa. This fossa is undoubtedly the point of entry of much of the contagion gaining access to the system through the tonsillar structures. It is a space lying at the upper part of the tonsil close to the anterior palatine arch, and was first described by His in 1885, and more recently by Paterson.¹ It has sometimes been mistaken for a large crypt, but is really not a crypt at all, being formed in an entirely different manner. From the free border of the palatoglossus muscle there arises a fold of mucosa stretching backward towards the tonsil, which it partially covers. His names this the *plica triangularis*. Its apex blends with the top of the faucial arch and becomes lost in the velum palati, the base disappears in the structures at the base of the tongue, while the free edge continues over the tonsil, which may, and often does, adhere to it. At the top of the tonsil and immediately behind the plica a curved probe may be passed into a cavity which extends for a variable distance behind the soft palate. This is the supratonsillar fossa or palatal recess, comprising the remains of the lower part of the original second visceral cleft.

The connective tissue of the reticulum of the tonsils and the follicles lying therein are in structure exactly like the ordinary lymph-nodes. In the reticulum lymph-spaces may be seen between the follicles or on their periphery, these not being shut off as in the ordinary node. These lymph-spaces are continuous with the afferent lymph-vessels which lie in the peritonsillar connective tissue. The tonsils are at the period of their greatest activity about the twenty-fifth year; from that time they atrophy and assume atypical shapes, appearing as irregular hard masses apparently without any distinct diverticula. This change may be the result of the inflammations of preceding years or it may be due to senile degeneration.

FIG. 199.



Right supratonsillar fossa, with plica pulled forward and upward. (Paterson.)

¹ Jour. Laryngol., 1898, vol. xiii. p. 165.

Also, the continued impact of food will tend to harden the cortex so as to make a sort of indurated rind, while the interior remains soft and pulpy. If the organ has been often inflamed, coarse connective-tissue septa are seen running through it.

Physiology of the Tonsils.—The epithelium, which is of the squamous variety, is being constantly shed in health and with great rapidity in disease, so that in some places it may be, at times, only one or two layers deep. It was formerly supposed that the intact epithelium prevented any absorption of infectious or other material, but this view is no longer tenable. Goodale¹ has introduced particles of carmine into the crypts of more or less hypertrophied human tonsils, and then, after a lapse of some time, removed the organs, subjecting them to microscopical examination, and found that absorption normally exists in the tonsils and takes place through the mucous membrane of the crypts.

Goodale² has suggested the possibility of treating enlarged cervical glands by means of iodine introduced into the tonsillar crypts, the remedy following the normal course of the lymph-stream. It must be admitted, therefore, that the tonsils are capable of absorbing all sorts of material from the mouth. When it is considered that in health the flora of the human mouth includes more than one hundred different organisms, it is not strange that the tonsils are in a constant state of siege, and that sometimes the enemy breaks down the barriers.

Much difference of opinion still exists as to the exact function of these organs. Perhaps the most reasonable view is that which assigns to the entire ring of Waldeyer, which stands as an outer sentinel about the entrance of both the air- and food-tracts, the rôle of a defensive organism, but whether this defence is by means of a phagocytosis or by other factors is still unsettled. Undoubtedly the muciparous follicles of the lacunae help to lubricate the bolus of food. Still further, the structural relation of the tonsils to the general lymphatic nodal bodies suggests that they may, like so many of the so-called ductless glands, have an internal secretion of their own.

Development of the Tonsils.—The anterior palatal arch is derived from the second visceral arch, which forms the dividing-line between the mouth and the pharynx. Below the soft palate the faucial tonsil is formed by the development of lymphoid tissue in the cleft between the second and third arches, the upper part of the space being the supratonsillar fossa. Between the fourth and fifth months of fetal life the anterior or palatal arch widens and forms the free edge of the plica triangularis. According to Kölliker, at the fifth month of intrauterine life the tonsil is a smooth sac with fissure-like openings and several small cavities; its internal or mesial aspect is that of a valve, the latter evidently being the plica.

¹ Arch. f. Lar., Bd. vii. S. 90.

² Boston Med. and Surg. Jour., 1898, vol. cxxxviii. p. 465.

Lymphoid tissue forms in the sinus or groove and almost fills it, thereby constituting the tonsil (Paterson).

According to Retterer, the first step in the development of the tonsil consists in the ingrowing of the epiblast into the hypoblast; the result being¹ a group of diverticula formed from the epithelial layer of the mucosa, the walls of which contain muciparous glands and lymph-follicles. These diverticula open in a uniform manner on the surface of the mass. The various tonsil groups differ from one another only in the arrangement of these diverticula: in the lingual tonsil they are single, but in the pharyngeal and faucial, compound. In the latter their arrangement is such that a number of them recede from the general surface of the group to which they belong, and in this way is formed a chamber called a crypt or lacuna. The real significance of this anatomical



Development of the tonsil. (Retterer.)

term should carefully be borne in mind, for in recent medical literature it has largely supplanted the word follicle as applied to tonsillar inflammations. Inflammation of the follicle is only one part of the lesion in the malady termed "follicular" tonsillitis. The follicle is not the diverticulum, but only one of the structures in the wall of the latter.

ACUTE TONSILLAR INFLAMMATIONS.—Under this heading will be considered acute superficial or catarrhal tonsillitis, acute lacunar tonsillitis, acute parenchymatous tonsillitis, acute croupous tonsillitis, and acute suppurative tonsillitis. The latter (quinsy) is at its culmination partly a circumtonsillar affection, though it may, and most often does, result from intratonsillar infection. Some of these forms may run into one another and represent different grades of severity of the infection.

ACUTE CATARRHAL TONSILLITIS.—This is an acute inflammation which expends itself mainly on the mucosa covering the surface of the tonsil, and does not extend to any marked degree into the lacunæ. It occurs more commonly in children, and is often one element in a general faucitis and pharyngitis.

¹ Harrison Allen, Trans. Amer. Laryngol. Assoc., 1891, p. 12.

Etiology.—Many attacks are referable to sudden changes in temperature; others are due to irritation directly, as from ingesta, or indirectly from bad gastro-enteric conditions. This latter cause is perhaps the most common. The affection is also seen in many of the contagious diseases of early years.

Pathology.—This is the simplest form of catarrhal inflammation of a mucous membrane, the latter at first becoming swollen and dry; later the secretion is increased in quantity, and with its re-establishment the swelling subsides. In the mouth of a young child it is difficult to distinguish these different stages, and there is apparent only a diffused redness and swelling. The secretion may appear as a pasty mass. The foregoing condition may subside without incident or go on to a more severe form of inflammation.

Symptoms.—These begin with a slight febrile movement and some discomfort in swallowing, together with pain and stiffness in the cervical muscles. Actual torticollis is not unknown. Pain may radiate to the ear, and in severe cases there may be some impairment of palatal function. Examination shows that the above condition is not actually limited to the tonsils, but extends more or less over surrounding structures.

Treatment.—At the outset the bowels should be moved by a mercurial and saline. If seen early, the tonsil may be touched with a solution of silver nitrate, thirty grains to the ounce. Guaiacol diluted in an equal amount of glycerin is also useful for this purpose, but care should be taken that none of the solution drops from the cotton carrier into the lower part of the throat. If the pasty secretion is troublesome, it is best removed by a spray of equal parts of hydrogen dioxide and lime-water. Internally, small and frequent doses of aconite and belladonna may be given, or the time-honored mixture of muriate of iron tincture in glycerin, which has held its own against the great number of remedies introduced by modern therapeutics. If the case is seen early, such a plan will often abort the attack, but, as a rule, cases do not come under observation until well under way. Under these circumstances the dioxide spray must be continued, and, with a view of making the patient comfortable, some of the new synthetic compounds, such as lactophenin, phenacetin, etc., should be given every two hours in dose proportionate to age, care being taken to note the effect on the heart's action. A small dose of caffeine citrate may be added if the heart is at all weak. As a rule, this form of tonsillitis lasts but four or five days, and patients frequently get well without any treatment whatever; but prompt intervention often wards off a more severe form of inflammation and renders the patient more comfortable, even though the duration of the affection may not be shortened.

ACUTE LACUNAR TONSILLITIS.—This is often associated with the parenchymatous form, and is the "ulcerated sore throat" of the laity. It consists of an inflammation of which the most striking objective feature

is the filling of the tonsillar crypts with whitish plugs, together with a general swelling of surrounding parts and a distinct febrile reaction.

Etiology.—The exciting cause most frequently given is exposure to cold, but it must be premised, in the light of our present knowledge, that this phrase has in its literal interpretation become meaningless. Taking cold implies a lessened power of resistance to the various morbid influences against which the body constantly contends, and its causative agency in the production of disease is, therefore, an indirect one. The flora of the mouth is very extensive, and constantly contains germs of a pathogenetic nature. Ordinarily, these are non-virulent, or may be rendered innocuous by the sterilizing properties of the buccal fluids; in other words, a sound condition of the general system nullifies their influence for harm.

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than usual care exercised to guard against exposures and excesses." He also calls attention to the fact that, while tonsillar inflammations become less common as age advances, rheumatic and gouty manifestations become more common. There is a possibility that malarial poison may cause tonsillitis. Chassaignac has seen cases in which there was a periodical exacerbation after painful symptoms, which, however, yielded promptly to quinine, though not responding to the usual methods of local treatment.

Chronic enlargements of the tonsils naturally invite recurring acute attacks. In some instances the latter are coincident with suppressed menstruation, which condition is supposed to lower the normal power of resistance to infectious organisms. Inflammation may also be excited by the irritation of foreign bodies and by exposure to the odors from defective drainage, which may be regarded as the type of a wide range of septic influences. Attendants in hospitals are frequent sufferers. The disease occasionally follows operations on the intranasal tissues, especially galvano-cauterization, not often from cutting instruments. The reason assigned is, that for a time after cauterization the filtering action of the nares is in partial abeyance, and that some of the bacteria in the upper air-tract are stimulated to an abnormal virulence.

Finally, there can be no doubt that certain foods, especially milk, may be carriers of contagion which may cause outbreaks of lacunar tonsillitis. Interesting testimony on this point is offered by Grey-Edwards and Severn.¹ They reported a series of cases in families all supplied with milk from the same farm. Bacteriological examinations of scrapings from the throats showed the presence of the staphylococcus pyogenes aureus and short streptococci, Klebs-Löffler and tubercle bacilli being absent. The milk-supply from different animals was then tested, and suspicion finally fell on one cow, whose milk was found to contain the same micro-organisms as those from the throats; pus-cells were also present. A change in the milk-supply at once checked the outbreak of tonsillitis. Other similar epidemics have been reported. It has been suggested that it is possible for the germs of scarlet fever to pass through the system of the cow in a modified form, so as to set up in man a milder and non-infectious simple tonsillitis.

It is a disputed point whether lacunar tonsillitis should be regarded under all circumstances as a contagious disease, though it seems so to be. Cases of direct contagion are often explicable on the ground of successive exposure of different members of the same family to the same unfavorable environment. Under such circumstances the period of incubation is about four days.

Pathology.—Either one or both tonsils may be affected. They are reddened and swollen, while the surrounding tissues are more or less œdema-

¹ Brit. Med. Journ., 1897, vol. ii. p. 339.

tous; this edema is usually especially marked in the soft palate and uvula, the latter being pushed to one side. The tonsillar crypts are filled with plugs composed of leucocytes, epithelial debris, various organisms, and possibly a little fibrin. Bacteria are more common at the mouth of the crypt, the bottom often being free from them. The leucocytes are polynuclear neutrophiles, many of them containing bacteria.

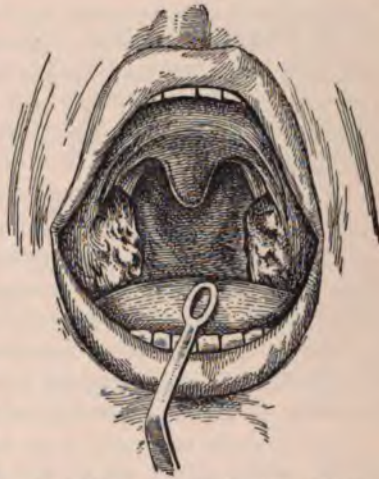
As to bacteriological findings, both staphylococci and streptococci are present. Fränkel¹ believes that the latter are the infectious elements. E. Meyer² found, in fifty-two cases, fourteen with staphylococci, generally aureus, twenty-four with a mixed culture of the two, and fourteen with streptococci in pure culture. A diplococcus resembling, and perhaps identical with, that of pneumonia has also been found. The varying proportion of these different micro-organisms causes no appreciable variation in the clinical features of the disease. Meyer's studies show that in normal conditions the secretion removed from the tonsils usually contains a coccus resembling the streptococcus pyogenes, staphylococci, and leptothrix growths. Hilbert³ found the streptococcus so universally present that he is unwilling to concede its etiological relation to tonsillitis, but regards its presence in the deposits of inflamed tonsils as merely secondary and accidental. He thinks that it may flourish in these deposits, and may find a way through the inflamed tonsils into the circulation and thus give rise to a general infection.

In very young children the lacunar symptoms are often overlooked, but close inspection of the fauces in many of the febrile attacks of infancy will show the tonsils studded with pin-point deposits, which are cryptic plugs so small that they are hardly visible.

ACUTE PARENCHYMATOUS TONSILLITIS.—The conditions described in the foregoing paragraphs may be present without any enlargement of the tonsil as a whole; often, however, it becomes greatly increased in size from the exudation of inflammatory products into its substance, presenting what is really a combination of the lacunar and parenchymatous forms, or the organ may be swollen while the crypts are clear.

A careful study of the changes seen in these two types of tonsillar

FIG. 201.



Acute lacunar tonsillitis. (Grünwald.)

¹ Arch. f. Laryngol., Bd. iv. S. 130.

² Ibid., S. 66.

³ Deut. Med. Woch., 1899, No. 43, S. 262.

disease has been made by J. L. Goodale.¹ He finds two varieties of lesions. The first is a diffuse proliferative change, the follicles being enlarged from an increase of their lymphoid cells and of the endothelial cells of the reticulum. Scattered along the latter are varying numbers of large phagocytic cells, which in some sections appear in irregular shapes, suggestive of amoeboid conditions. They contain in their interior numerous cell-fragments from lymphoid or red blood-disks, the inter-follicular regions showing a similar increase of proliferation and lymphocytes with occasional phagocytic cells. As the section is made in the deeper planes of the organ towards the mucosa, the cytoplasm of the lymphoid cells becomes more abundant, while their nuclei are more coarsely granular and lie eccentrically. Polynuclear neutrophils are scattered through the interfollicular region, and may occasionally be seen escaping through the walls of the blood-vessels; nowhere are they collected into groups. The cells of the mucosa show an active proliferation and exfoliation.

A second variety of lesion found by Goodale in four out of sixteen cases examined is that of small abscesses beginning in the interior of the follicles, enlarging, and finally bursting into the crypts. In one of these cases a single small abscess was found only after examining many sections, in two others about every tenth follicle was thus affected, while in the fourth nearly every follicle showed the minute suppurating foci. This group of cases presented histories of inflammatory symptoms lasting from four to six days previous to the excision of the tonsil.

The present tendency is to regard these forms of tonsillitis as of the nature of an acute infectious disease. Careful examination shows in many of them an enlarged spleen, albuminuria, various rashes, etc., followed at times by pleurisy, pneumonia, and irritation of the testes or ovaries.

Symptoms.—The symptoms of both the lacunar and parenchymatous forms are practically the same. General manifestations may precede or follow the local. The former assume the type of an acute infection. There is generally more or less chilliness, followed by a rapid rise of temperature (104° F.), with corresponding changes in pulse-rate and respiration. Headache, constipation, thirst, anorexia, general malaise, and bodily pains soon occur, with an amount of prostration out of all proportion to the apparent severity of the local condition. It has truly been said that there is no surface of equal size in the whole body the inflammation of which is attended by such severe disturbance as is the area of the tonsil; in bad cases there may be clammy sweating, restlessness, insomnia, and even delirium. The local symptoms begin with a burning or pricking feeling, which soon passes to actual pain, and it becomes increasingly difficult, especially when the tonsil is enlarged, to open the

¹ Jour. Bost. Soc. Med. Sci., January, 1899.

mouth. The cervical glands may be swollen and painful, the pain radiating to the ear, and partial blunting of the senses of hearing, smell, and taste is not uncommon. From the local swelling a sense of suffocation may result, and be most distressing. The throat fills with a thick, tenacious mucus, and attempts at its removal by clearing the mouth or by swallowing greatly increase the patient's distress. Speech becomes thick and may be indistinguishable, the tongue is coated, and the breath offensive. Taking of food becomes agonizingly painful, and fluids may regurgitate through the nose from abrogation of palatal function. Persistence of the fever occasionally brings out an erythema which is sometimes mistaken for that of scarlet fever.

Differential Diagnosis.—Scarlatinal throats sometimes present lacunar deposits, but the disease is usually ushered in with vomiting. The question is settled by the appearance of the characteristic exanthema in twenty-four hours, the latter being more diffused and persistent than is the simple fugitive erythema of a febrile state. The faucial congestion in scarlet fever is generally much more extensive than in tonsillitis, though the actual swelling is less; the "strawberry tongue" of the exanthema is also of use in forming a conclusion.

In syphilitic sore throat, which may present febrile symptoms, the redness is generally symmetrically distributed, the congestion is of a duller red color, and the pain is not severe,—in fact, may be absent. It is from the superficial or catarrhal form of tonsillitis that specific disease requires differentiation. Careful inquiry should be made regarding a possible syphilitic exposure.

From diphtheria the diagnosis is at first by no means easy. Beyond all question there may be a diphtheria confined to the lacunæ, on the walls of which the exudate appears; to the eye and in its clinical manifestations it resembles the lacunar form of tonsillitis, and a positive decision must rest upon bacteriological findings. Doubtless many of the cases of reported contagion in lacunar tonsillitis have been actual diphtheria. In diphtheria the exudate is apt to appear in larger patches, usually begins on the velum and uvula, is generally of a grayish hue, and is of a more ragged appearance. In pure tonsillitis an apparent exudate may be brushed off, as it is only mucus which by the action of the palatal muscles has become evenly diffused over the tonsils, suggesting a true diphtheritic membrane. A bleeding surface after removal is no proof of true (Löffler) diphtheria, but only of a croupous inflammation,—that is, an exudation with degeneration or death of tissue. According to Heubner (quoted by Schech), it is "not at all impossible that spasm of the superficial capillaries of the pharynx (excited reflexly by cold) may be followed by complete cessation of the circulation and croupous exudation."

Course and Duration.—The duration of either form is from one to fourteen days, the average being five or six. The prognosis is good, though

a few cases have resulted fatally from supervening œdema of the larynx. If the affection frequently recurs the tonsils may become permanently enlarged, and there is always danger of quinsy.

Treatment.—If the disease is seen at the outset it may be aborted by thorough purgation and painting the tonsils with pure guaiacol, strong cocaine solutions, silver nitrate (fifteen per cent.), or by frequent spraying with solution of suprarenal extract or its active principle, adrenalin. After exudation has occurred the latter is of no use whatever, and simply aggravates the dryness of the throat, thereby increasing the patient's discomfort. Small and frequent doses of aconite and belladonna or of opium may be given. Emil Meyer advises the use of morphine, one-twenty-fourth grain, with Norwood's tincture of veratrum, two and one-half minims, given hourly for three hours, then less frequently; his experience has led him to believe that this combination is a tolerably sure preventive against the progress of the case towards suppuration. Another familiar combination is that of the "tonsillitis" tablet triturate, each one containing tincture of aconite, one-fifth minim; tincture of bryonia, tincture of belladonna, of each, one-tenth minim; red iodide of mercury, one-one-hundredth grain. Of these one may be taken hourly for three hours, and one every three hours thereafter until the subsidence of the inflammation. Care must be taken to watch the effects of the mercury. At the outset cold compresses may be applied to the neck, while if the case has fully developed, hot applications are generally more grateful. Frequent spraying with solutions of equal parts of hydrogen dioxide and lime-water will clear away the thick mucus, while the pain is relieved by rinsing the mouth with a solution of sodium bicarbonate (a teaspoonful to a glassful of water as hot as can be borne).

Many patients prefer to be their own doctors for a while, and, as a consequence, by the time they come under observation the process is well advanced. For treatment in this and in the later stages nearly every drug in the Pharmacopœia has at some time or other been recommended, thus evidencing the fact that there is no specific for the malady. Guaiac in the form of troches or the ammoniated tincture in drachm doses in milk long enjoyed favor, based, no doubt, on the theory of rheumatic causation. In the writer's hands its effects have been very uncertain, and it is extremely disagreeable to take in any form. For some years he has relied on salol in five-grain doses (adults) hourly, exhibited in mucilaginous suspension and flavored with some essential oil, this method of taking having proved more reliable than the use of tablets. In a series of eighty-one cases it was found that if treatment was begun on the first or second day of the disease, pain was, on the average, relieved in twelve hours; if begun on the third day, in fourteen hours; and if begun after the third day, in eighteen hours. The average of all the cases was a little over fourteen hours. Allowing for sleep, not more than ninety grains are taken in the twenty-four hours, and experience

has shown that in persons with sound kidneys this quantity is perfectly safe. In a few cases of the foregoing series a dark color was observed in the urine, but nothing more. Other preparations which may be used in place of salol are lactophenin, sodium salicylate, sodium benzoate, antipyrin, acetanilid, and the muriatic tincture of iron; recourse to the latter after failure with some of the newer and much-vaunted remedies is often rewarded with success. Estimation of the value of any plan of treatment must recognize the self-limited nature of the affection. During the administration of the coal-tar products the heart must be closely watched. Nuclein prepared from the thyroid and thymus glands may be given in the same dosage as salol and is warmly recommended by some writers.

Incisions, scarifications, or punctures are not recommended in these forms of tonsillitis. If the lacunæ seem small and their mouths are distended with inflammatory plugs, it is a good plan to remove the latter with a small spoon scoop, and by means of a cotton carrier rub over the interior of the lacunæ with guaiacol. This plan is highly extolled by Goldstein,¹ who has also used for this purpose protargol, trichloracetic acid, and the Löffler solution (page 694). He advises these applications at intervals of eight hours, and he completes the local treatment with a gargle of solution of chloride of iron in glycerin. In addition, he lays stress on three therapeutic procedures: (1) a saline purge, (2) free diaphoresis with pilocarpine and wrapping in blankets, and (3) saturation of the system by a salicylate or by sodium benzoate.

Parenchymatous injections of various remedies have also been suggested. For this purpose carbolic acid (two or three cubic centimetres of a two per cent. solution) has been used, and also solutions of iodine. The latter remedy has been applied by cataphoresis.

Finally, *every* case of sore throat should be isolated until its exact nature is beyond question.

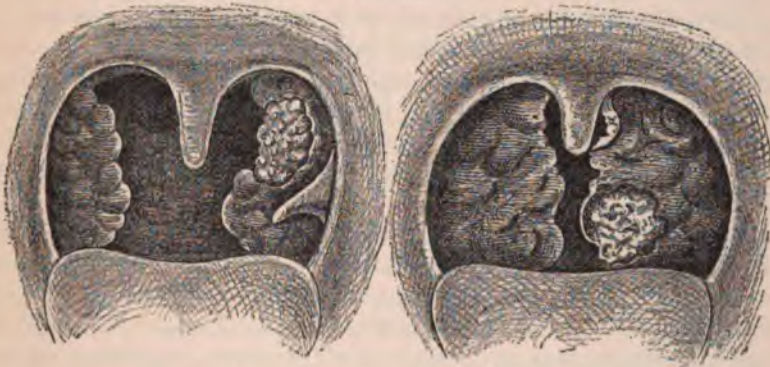
ACUTE CROUPOUS TONSILLITIS.—By this term is signified an inflammation with degeneration or death of tissue. The epithelial covering of the tonsil may be alone involved, or the change may extend through the entire mucosa, with swelling of the surrounding tissues. The exudative material is rich in fibrino-plastic substances, and appears on the surface of the mucosa, forming a false membrane.

Etiology.—This form of tonsillitis is often seen as a complication of the various exanthemata and infectious maladies, and some cases appear in the later stages of kidney disease and of wasting maladies. Croupous tonsillitis may also result from many of the causes commonly leading to the lacunar form. In one sense it may be said that the special form produced by the Löffler bacillus is a croupous tonsillitis, but this has reference only to physical appearances. Undoubtedly various micro-

¹ Laryngoscope, 1900, vol. viii. p. 215.

ACUTE ULCERATIVE TONSILLITIS.—Under this title F. J. Moure¹ has described a form of tonsillar disease which he regards as a subvariety of ordinary lacunar tonsillitis. It is characterized by the presence on the surface of the tonsils of large ulcerated patches which closely resemble specific lesions. Attention had been called by various observers in previous years to this class of lesions, but Moure seems to have been the first to recognize their true nature. The tonsils present, more frequently on their mesial aspects, grayish rounded or oval patches covered with a cheesy deposit of some thickness, which can, however, easily be removed, leaving a mammillated surface. The borders of the ulcer are clean cut, but not particularly swollen; the rest of the organ may be somewhat swollen. The ulcerated spots are usually single, without any tendency to coalesce, and may occur in succession on the same tonsil,

FIG. 203.



Acute ulcerative tonsillitis. (Moure.)

so that the latter exhibits simultaneously different stages of the lesion. The ulcers seem to be of an infective nature, which may explain the successive invasions of the same or of the other tonsil. The process appears to start as an acute inflammation in the crypts. Moure compares the gross appearance to that of a cauterized tonsil from which the slough is about to separate.

Etiology.—The condition seems to be more prevalent in the spring and fall, and attacks by preference young adults; no special cause has yet been assigned for this particular form. The affection has also been styled ulcerous chancriform tonsillitis, and more recently has been referred by Vincent and others to the special influence of a spirillum and certain fusi-form bacteria, but this point is still undecided. Some have regarded the malady as merely a manifestation upon the tonsillar surfaces of the usual ulcero-membranous stomatitis which is seen in other parts of the mouth.

¹ Rev. Internat. de Rhinol., 1896, vol. vi. p. 101.

Symptoms.—The symptoms of this form are identical with those of an ordinary attack of lacunar tonsillitis. Adenopathy is rarely, if ever, observed.

The particular form of ulcer under discussion does not spread by continuity, and remains strictly limited to the tonsils, while the tissue intervening between the multiple lesions is always unaffected. Moreover, the edges of the syphilitic ulcer are surrounded by an angry red zone of progressing infiltration, which is entirely wanting in the lacunar ulcer.

Treatment.—The treatment should consist of a thorough cleansing of the surface of the patches with hydrogen dioxide or with the preparation known as "enzymol," which is a proteolytic ferment of considerable power, yet without harmful effect upon normal tissues. The writer heartily recommends this remedy as being particularly efficient in cleansing the surface in various forms of ulceration of the throat, and in cases of dead tissue it has seemed far more efficient than hydrogen dioxide. Next, the cleansed area should be thoroughly swabbed with a solution of zinc chloride (1 to 30) containing a little cocaine, and the cure is completed by the use of a strong gargle of potassium bromide in glycerin and water. Initial curetting of the affected area or discission of the tonsil has been recommended. Finally, it seems hardly necessary to say that during the active stage all food should be bland and that there should be a most careful avoidance of pharyngeal irritants.

ALBUMINURIC TONSILLITIS.—G. F. Keiper¹ has reported a case under this heading and added some observations on its pathology. His patient was a man thirty-two years of age, with grave renal trouble. The superior portion of the left tonsil showed an ulceration the size of a gold dollar, which was covered with an exudate suggestive of diphtheria; this was, however, easily removed without hemorrhage, leaving a surface as if scraped out with a sharp spoon. Within three or four days severe bleeding took place from the site of ulceration. There were several recurrences of the hemorrhage, which finally ceased of its own accord, and did not recur; but death soon followed, owing to the general constitutional condition. In such cases there are probably vascular changes analogous to those found in albuminuric retinitis, in which the walls of the arteries are transformed into homogeneous yellow tubes with narrowed lumen. In this condition the blood-stream is retarded and the toxic substances in it remain longer in contact with the vessel-walls, and hence the latter become diseased by fatty degeneration of the endothelium and narrowed by proliferation. When the laminae become considerably reduced or obliterated a dropsical necrosis results, as well as an extravasation of the constituents of the blood, together with hemorrhages. Cases such as that reported by Keiper are infrequent in literature, but if the foregoing train of reasoning be correct, it is hard to understand why this

¹ Laryngoscope, 1898, vol. v. p. 275.

complication in the throat does not recur more often, considering the constant irritation to which the vessels at this point are exposed.

GANGRENOUS TONSILLITIS.—In the later stages of certain chronic visceral diseases there may be an actual gangrene of the tonsil. As evidencing low vitality this is an omen of gravest prognostic import; nor is it without local danger, as Cragin¹ has recorded the case of a man forty-five years of age whose death was caused by a sudden and copious bleeding from the mouth. Autopsy showed a large ulcerated area with attached slough occupying the site of the right tonsil and reaching back towards the posterior wall of the pharynx. Corresponding to the site of the tonsil, two small vessels with open mouths were detected, which were evidently the source of the bleeding.

Not all cases of gangrenous tonsillitis, however, are fatal. De la Sota² has seen three recoveries under the use of tonics and local antiseptics.

ACUTE CIRCUMTONSILLAR INFLAMMATION (QUINSY).—In this condition the focus of inflammation is generally located in the connective tissue around the tonsil, especially in front and above. The term "suppurative tonsillitis" is objectionable in that it signifies that the abscess is in the tonsil itself, which is not often the case. The position of the organ with reference to the supratonsillar fossa has already been described, and the exact site of the pus collection has been demonstrated by F. C. Cobb,³ who injected a cadaver through the tonsil, using liquid wax, which was passed by means of a needle through the superior constrictor muscle into the pharyngomaxillary space. The material passed in easily and produced on the palate the bulging characteristic of quinsy. After the wax had hardened, sections of the part were made just below the hard palate, showing that the space was filled towards the region of the teeth anteriorly and that the wax also extended into the soft palate. Posteriorly the injection was stopped by the partition formed by the styloglossus and stylopharyngeus muscles. Removal of the wax left a cavity that would easily have accommodated half a fluidounce, and which extended not only beneath the tonsil but above into the soft palate. Cobb believes that the phenomena of quinsy are easily explained by the accumulation of pus in this space.

It is not asserted that all quinsies have this exact location or that the pus always burrows along the lines indicated. Sometimes it oozes from the lacunæ, and excision of the entire tonsil will show a pus-producing cavity at its base; but even here the discharge seems to be fed from some reservoir behind, for it has been demonstrated that if all the pockets at the base of the organ and about the supratonsillar fossa are thoroughly opened up and allowed to heal from the bottom, suppuration rarely returns.

¹ New York Med. Jour., September 1, 1888, p. 233.

² Cf. Sajous's Annual, 1892, vol. iv. E. 12.

³ New York Med. Jour., October 14, 1899, p. 571.

Etiology.—According to Lennox Browne, quinsies form about thirteen per cent. of all acute inflammations in this region. The general causes are the same as those peculiar to the varieties of tonsillitis already described. Any case beginning as a lacunar or parenchymatous form may go on to suppuration, and this emphasizes the fact that quinsy is a direct infection of the circumtonsillar tissue through the route of a diseased tonsil. Most of the cases occur in young adults, though the disease has been seen at all ages from seven months to seventy years. Neglected attacks of acute inflammation seem to predispose to it.

Bosworth states that he is "disposed to make the assertion that a suppurative inflammation in the cellular tissue surrounding the faucial tonsil in probably nine cases out of ten should be regarded as a manifestation of rheumatism." He further states that "an acute follicular tonsillitis

does not and cannot develop a quinsy without some particular predisposing cause."

Pathology.—This affection is a simple phlegmonous inflammation in the connective tissue surrounding the tonsil, which latter may be pushed inward from its bed and appear enlarged when it is really not so. It shares in the general congestion and oedema of the surrounding parts. Occasionally the suppurative process invades the tonsillar substance. The abscess is more apt to point in the anterior pillar at its upper part or between it and the tonsil; it may, however, point in the posterior pillar. A possible danger is the burrowing of pus downward into the cellular tissue of the deeper parts of the



FIG. 204.
Circumtonsillar suppuration. (Grünwald.)

neck, and through it into the mediastinum or the pleural cavities, with fatal result. In view of such possibilities it is surprising that some authorities still counsel against opening quinsies, preferring to wait for spontaneous evacuation.

Symptoms.—If the suppuration is secondary to a preceding tonsillitis there may be engrafted on the symptoms of the latter an additional rigor with high fever and profuse sweating. The whole side of the anterior pharynx becomes tense and brawny, while the soft palate is pushed forward or may be invaded by the purulent process. A tumor can often be felt on the outside of the neck. It is difficult or even impossible for the patient to open the mouth wide enough to introduce a tongue depressor, swallowing is agonizingly painful, the uvula may become oedematous and obstruct free respiration, taste and smell are blunted, the voice has a peculiar sound suggestive of the condition, the fauces are clogged up with thick, tenacious mucus, and the breath becomes horri-

bly offensive. The patient is in a miserable condition, with saliva constantly dribbling from the mouth, and after a siege of three or four days, with its enforced starvation owing to inability to swallow, is often reduced to a condition of very low vitality.

If left to itself, and if only one tonsil is attacked, the disease generally run its course in from one to ten days. If an abscess forms, it will probably burst by the end of a week. All cases do not result in actual pus formation, the swelling subsiding after a lapse of several days. The involvement of the second tonsil means, of course, a prolongation of the disease. Occasionally a case will continue indefinitely, the process neither subsiding nor going on to suppuration. The febrile movement is of varying intensity, and its subsidence does not necessarily mean that no pus is present, for there are suppurative cases in which the pus is shut in by a wall of inflammatory material, so that there is no longer any absorption from the abscess-cavity, or, at least, not enough to cause fever. Under these circumstances all the constitutional symptoms may subside while the local continue.

Prognosis.—Recovery is the general rule, and it is prompt when once the pus is evacuated. A serious though rare complication is œdema of the glottis. The abscess may burst after swallowing, coughing, or during sleep; in the latter case the pus may be swallowed or may enter the trachea, causing suffocation. It is not always easy to find the exact site of the exit of pus when spontaneous evacuation has occurred. In addition to the invasion of the mediastinum, there may be abscesses in the submaxillary glands or lingual muscles; erosion of the great vessels has taken place, and general septicæmia is not unknown.

Treatment.—At the outset circumtonsillar inflammation calls for the same general treatment as the acute forms of tonsillitis. Quinine, Dover's powder, aconite, etc., may be given in small and frequent doses with the view of aborting the attack. Ice-pellets may be held in the mouth and ice applied externally. If pus formation seems imminent, hot sponges or poultices are preferable. Helbing¹ has proposed as a revulsive measure the application of croton oil at the angle of the jaw, and hot alkaline washes help to keep the mouth clear of the thick mucus. Early incision is advocated, and in the opinion of the writer is admissible as soon as there is much protrusion of the anterior pillar; it should be followed by a flushing out of the mouth with a hot antiseptic solution. Where pus is suspected, the blade of the scalpel should be passed in horizontally (at least half an inch) through the site of greatest bulging, the direction of the incision being from without inward towards the median line of the mouth. As the blade is withdrawn it should be turned half-way round so as to leave a larger opening and one which the parallelism of the muscular fibres will not immediately close up. Cobb

¹ Centralb. f. Lar., 1890, S. 564.

has called attention to the fact that the fibres of the anterior pillar and those of the superior constrictor cross one another at an angle, and to this is due, he thinks, the occasionally ineffectual results of puncture.

Sometimes the incision is not followed by the immediate escape of pus, but the latter may suddenly make its appearance a while after. In such a case the point of the knife has probably penetrated nearly to the purulent focus, and has so weakened the wall of the latter that spontaneous evacuation soon follows. Mere superficial punctures or scarifications are to be avoided, as they do no good and increase the patient's discomfort. If pus does not follow the first incision, a second, or even a third, may be made. Incision "acts at once by relieving tension, while bloodletting mitigates, and sometimes even cuts short, the disease." The gentle and careful syringing of the pus-cavity with a mild antiseptic by means of a long curved tube has seemed to hasten convalescence. If swallowing is so painful as to interfere with nutrition, the fauces should be sprayed with a cocaine solution, after which food may be taken. The bowels should be kept open and a supporting regimen followed. Rectal

FIG. 205.



Leland's tonsil knife.

alimentation has at times been necessary, and stimulants may be given in moderation.

A word should be added in reference to after-treatment in cases of recurring quinsy. Diseased lacunæ should be opened, the supratonsillar fossa freely exposed, and, if feasible, a portion of the tonsil removed. G. A. Leland¹ advocates the splitting of the tonsil from top to bottom with a sickle-shaped knife and the subsequent insertion of the sterilized forefinger, by which means the base of the tonsil is thoroughly explored and all pus-pockets completely destroyed. The advantages claimed for this method, which requires slight general anæsthesia, are, first, the pus-pocket is definitely located; second, the abscess is drained from the bottom; and, third, recovery is prompt and the process does not recur.

INFLAMMATION OF THE LINGUAL TONSIL.—The lingual or fourth tonsil is the collection of lymphoid tissue on the back of the tongue between the circumvallate papillæ anteriorly and the anterior surface of the epiglottis posteriorly. It is one segment of the "tonsillar ring," and presents no peculiarities in either physiology or pathology. Structurally,

¹ Trans. Amer. Laryngol. Assoc., 1899, p. 53.

its diverticula are single instead of compound, as in the faucial tonsils. This lymphoid deposit may scarcely appear above the surface of the tongue, or may be in the form of a large central mass or of two masses placed one on each side of a median furrow; it may be so prominent as to shut off the view of the glosso-epiglottic fossa. The surface of the mass is generally mammillated, and occasionally the epiglottis is fairly buried in it, the condition being known as "incarceration of the epiglottis."

Etiology.—The causes and varieties of acute inflammation of this tonsil are the same as those of the faucial deposits. This localization of throat lesion is often overlooked from faulty methods of examination. The tongue should be held as in laryngeal examinations (page 592) and the large mirror employed, but not placed so far back in the mouth as is necessary to bring the vocal cords into view. It has been asserted that poisonous saliva from dental caries has a specially detrimental effect on this particular tonsil.

Symptoms.—The general symptoms are the same as those enumerated under the headings of inflammations of the faucial tonsils. The local symptoms vary somewhat, due to the different area affected. Thus, the feeling as of a foreign body in the throat is especially marked, as is also, for obvious reasons, painful swallowing. Pain at the root of the tongue is constant, while irritation of the structures at the entrance to the larynx causes frequent cough.

In the lacunar type of attack the constitutional symptoms are apt to be more severe than in the corresponding inflammation of the faucial bodies. The swelling may spread to the epiglottis, and even to the tissues around the glottic opening, thus causing dyspnoea, at times alarming, and possibly requiring operative intervention. The initial pain may be referred to the hyoid region, or even over the larynx, so that it is often difficult to persuade patients that the latter organ is not the seat of the disease. The parenchymatous form is the one most often seen, and calls for no special remark.

The circumtonsillar or suppurative variety (lingual quinsy) is less common than the faucial, owing to the relatively scanty amount of connective tissue at the base of the tongue. The special demand in these cases is to determine the exact site and nature of the inflammation with which the practitioner has to deal, and both the finger and mirror should be used as guides to diagnosis. It is well to remember that these attacks are sometimes ushered in by an œdema of the glottis. Spontaneous evacuation of the abscess during sleep, especially if it be posterior, introduces an element of great danger. Cases of chronic abscess of this region and of retention cysts are on record.

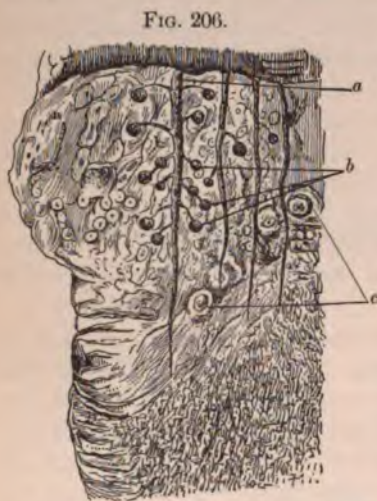
Treatment.—The treatment of these various forms of lingual tonsillitis is identical with that of corresponding lesions of the faucial structures. As local applications tannin and morphia may be used, care being taken

not to exceed a therapeutic internal dose of the latter, glycerite of boroglycerin, weak solutions of cocaine or eucaïne, menthol (fifteen grains) in olive oil (one ounce), etc. During the acute stage the inhalation of the vapor of boiling water poured on hops is gratefully borne, and convalescence may be hastened by swabbing the area with a solution of perchloride of iron in water, one part to eight. Most of these cases are not of a serious nature, but one must be prepared to act promptly, as some of them are so severe as to suggest that condition known as "Ludwig's angina." The similarity of the symptoms to those of retropharyngeal abscess is apparent, but palpation will readily determine between the two.

ENLARGED LINGUAL VEINS—LINGUAL VARIX.—Enlarged veins are frequently seen coursing over the region of the lingual tonsil, and give

rise to a well-defined train of symptoms. In addition they may be tortuous and irregularly dilated, giving a varicose appearance. The title "hemorrhoids of the tongue" has also been applied.

Etiology.—The condition is more liable to occur in neuropathic patients and in those suffering from any chronic visceral disease which prevents venous return. Torpid livers, chronic digestive disorders, rectal hemorrhoids, and lingual varix often go together. Lennox Browne, who has described the affection in great detail, has seen two cases in association with diabetes, and it seems occasionally to be one of the local manifestations of a general tendency to vasomotor neuroses. It is rare before the twentieth year and very common about



Lingual varix. (After Lewin.) *a*, venous trunks; *b*, terminal plexus; *c*, circumvallate papillae.

middle life. The majority of the cases seen by the writer have been women at the menopause.

Pathology.—The veins appear as a net-work of dark reddish or reddish-blue streaks or bands, with here and there local enlargements or nodosities, small ampullæ in which the blood stagnates; the deeper veins may be in a similar condition, while the lingual tonsil itself may or may not be enlarged (Fig. 206).

Symptoms.—These are much the same as those of simple enlargement of the tonsil, with the important addition that the vessels may from time to time rupture, thus giving rise to small hemorrhages which greatly alarm the patient, as he is apt to refer them to tubercular trouble in the lung. Browne has seen two cases of torticollis, in one of which removal of enlarged lingual veins relieved the muscular spasm.

Treatment.—The diet should be regulated and the bowels kept open. If the tonsil is large, it should be removed by methods to be mentioned later, while if the veins alone are dilated, they can be destroyed by the galvano-cautery at a dull-red heat. The patient should be cautioned to avoid for a while all hot ingesta and irritants. Sips of ice-water afford much relief to the after-smarting, which, however, is not excessive or of long duration, and various sedative troches may also be used.

CHRONIC INFLAMMATIONS OF THE TONSILS.

Under this heading are included the same varieties of chronic as of acute tonsillar inflammations. The chronic catarrhal variety is really one feature of a chronic pharyngitis and calls for no special remark.

CHRONIC LACUNAR TONSILLITIS.—This form may succeed a series of acute attacks or may be present without antecedent history. The tonsils may or may not be enlarged. From time to time the crypts become filled with cheesy masses; inflammatory bridges of low-grade connective tissue occlude the lacunar orifices, and thus lead to accumulation of cheesy material. Sokolowski thinks that there may be a villous ingrowth of epithelium into the lacunæ, each minute villus containing a lymph-follicle. Retention of contents leads successively to irritation, dilatation, and inflammation. These plugs, which emit a very offensive odor, are of a yellowish-white color, and composed of epithelial *débris*, leucocytes, fatty granules, cholesterin, mineral salts, and various bacterial and mycotic elements. The lacunæ at the top and bottom of the tonsil are most commonly affected, and pressure on some other part of the organ will often express their contents. This is the "caseous tonsillitis" of some writers. It is at once evident that the condition interferes with the proper function of the tonsils and the outpouring of the normal lymphatic stream. Naturally, the movements of surrounding structures in deglutition tend to keep the lacunæ free.

Symptoms.—Minor degrees of this condition are very common, and small deposits do not necessarily cause any symptoms whatever. If they are large, if many lacunæ are affected, and the process one of long duration, there is more or less faucial irritability with actual pain, possibly radiating to other parts of the throat, or even to the ears, and increased on swallowing. The breath is fetid and the tongue frequently coated. Swallowing of saliva is often more painful than swallowing of food, and morning cough is frequently present. Excessive use of the voice or excess in tobacco increases the discomfort. From time to time the patient may expel the plugs, whereupon relief follows until their reaccumulation. The mental condition of these patients is sometimes deplorable, as they imagine that they are affected with a grave and incurable malady.

Diagnosis.—Inspection as ordinarily made will be without result. The faucial pillars must be carefully separated from the tonsils, the probe

used, and all the crypts thoroughly explored. Three definite sites must be carefully scrutinized: (1) the upper part of the tonsil between the pillars (supratonsillar fossa); (2) the bottom of the tonsil just where the lymphoid deposit is stretching out to join a corresponding extension from the lingual tonsil; and (3) the middle of the tonsil (Gumpert) immediately behind the anterior pillar, or the area which so often becomes covered with the plica tonsillaris. The condition is frequently overlooked and the dysæsthesia variously referred to lingual veins, enlarged pharyngeal follicles, hysteria, etc.; meanwhile the patient gets no better, and may begin to complain of pains in the neck and chest and of various neuralgias. Should the disease continue, acute inflammation may supervene. There are here ideal conditions for bacterial growth, and after exposure to cold or the ingestion of hot or irritating foods the imprisoned bacteria may take on increased virulence with the usual result of an acute outbreak.

Treatment.—After locating the seat of the disease with a probe, each lacuna should be cleaned out by some spud-like instrument or scoop and the inflammatory bridges thoroughly slit up with some form of hooked knife. The bared areas should then be carefully curetted and rubbed with a cotton carrier dipped in a solution of iodine and potassium iodide, one drachm of each to an ounce of water. If the mouths of the lacunæ are relatively high up on the surface of the tonsil while their cavities extend downward, a cautery tip bent to fit each individual area should be passed to the bottom of the recess and the current allowed to burn its way out. This treatment will generally effect a permanent cure. Large tonsils should be removed *en masse*.

CHRONIC PARENCHYMATOUS TONSILLITIS.—By this term is meant the familiar condition known as “enlarged tonsils.” It may be the legacy of preceding acute attacks, or may occur so early in life that it is impossible to say just when it began. It is a striking expression of the tendency to lymphatism seen in young children, especially those of a strumous diathesis or who are exposed to bad general hygiene, being emphatically a tenement-house disease. It is seen, however, in adults and in those comfortably housed and fed.

Pathology.—One or both tonsils may be enlarged and of varying consistency, according to the relative amounts of lymphoid and connective-tissue elements. In the child, and in recent cases in young adults, the organ feels soft and pulpy, while in cases of longer duration it is hard and fibrous. Tonsils may be enlarged from vascular conditions or from inflammatory œdema, but here there is a true hyperplasia, or increase in the number of lymphoid elements. On inspection of the excised organ, the connective-tissue element is frequently visible to the naked eye, appearing in the form of trabeculæ running through the mass, which by their contraction become more or less lobulated. These connective-tissue trabeculæ bear directly upon the question of hemorrhage after removal

of the tonsils. In the soft organs the vessels retract after section of the tissue, and their mouths quickly become plugged with coagula as under ordinary circumstances; but where the connective-tissue element becomes excessive their mouths are held open after section, and the vessels, as a whole, do not retract within their sheaths, but become canalized. It is true that the organ may feel soft at its surface, but it may be quite hard at the plane of section, and its general state invites frequent exacerbations of acute inflammation. The combination with the enlargement of diseased lacunæ leads, as explained in the preceding section, to a clogging up of the lacunæ and the accumulation of various waste products behind these obstacles. Removal of a section of surface tissue corresponding to the depth of these lacunæ will often give temporary relief, but such a procedure is mentioned only to be condemned. It is fallacious in its results, for it is not sufficiently thorough, and the continuance of the conditions which caused the original lesion will lead to its recurrence.

As previously mentioned, the anterior faucial pillar often appears as a broad and thick membrane which projects

partially over the anterior half of the tonsil, and by a process, apparently of contraction, has pressed and partially rotated the organ backward on its vertical axis, so that whatever portion of its free surface remains uncovered presents towards the posterior pharyngeal wall. This band is sometimes the pillar itself, but at others a structure quite distinct therefrom, and the two should be separated before removal of the tonsil is attempted. The posterior pillar may also be firmly adherent, though no fibrous band develops in this situation.

Symptoms.—Enlarged tonsils are in a sense foreign bodies; they accordingly give rise to physical symptoms, but as they represent the outcome of perverted physiological processes, they present in addition symptoms referable to the systemic condition. Physically, all functions of the

FIG. 207.



Hypertrophy of the faucial tonsil. (Seifert and Kahn.)

surrounding parts are more or less hindered. An enlarged pharyngeal tonsil (so-called adenoids) frequently coexists, and it may be difficult to determine to which of the two diseased areas a given symptom is due; but as both areas are essentially a continuation of one and the same structure, this point is of minor importance. Certain it is, however, that the removal of enlarged tonsils, by allowing perfect postnasal drainage, will often afford relief to many of the symptoms attributed to postnasal disease. The voice is thick and muffled, the patient often speaking as if the mouth were full, some of the normal resonance of phonation is lacking, and breathing is somewhat interfered with. In the adult dyspnoea is rare. In children the oropharynx is encroached upon to such an extent that the function of the nasopharynx is also interfered with, and a slow carbonæmia occurs. Snoring and mouth-breathing may be present, and the need of oxygen frequently becomes so great that the child will wake up suddenly, presenting the familiar picture of night-terrors. The senses of hearing, smell, and taste are all blunted; the enlarged tonsils also directly interfere with the free action of the delicate muscles which govern the functions of the Eustachian tubes.

While in adults enlarged tonsils may cause only discomfort and impairment of special sense, the case is quite different in growing children, who are apt to suffer from defects in general physique and especially in chest development. After operation they will sometimes improve as if by magic. Doubtless many chest deformities supposed to be due to enlarged tonsils should be ascribed along with the latter to some underlying dyscrasia, both being effects of one common cause.

In addition to the foregoing symptoms, it may be added that the breath is offensive, the stomach disturbed, and the bowels out of order; nocturnal enuresis is also often present. The inspired air passing over surfaces which contain decaying materials in their crypts offers to the child a vitiated atmosphere.

Diagnosis.—While a casual inspection reveals the enlarged tonsils, the act of gagging brings them even more prominently into view.

Treatment.—The first thing to be decided is the exact character of the enlargement, and this can to a certain extent be predicted from the age of the patient and his previous history as regards tonsillar attacks. Under such circumstances the operator naturally looks for a more or less fibrous tonsil, one which is liable to bleed. The tonsil of the recent case, or of the young child, will be soft, evidencing the preponderance of the lymphoid element over the fibrous. In any event, the region should be carefully palpated before operative intervention, though even then one cannot predict the amount of connective tissue which may exist at the exact plane of section.

No reliance can be placed on the probability of spontaneous atrophy, though some surprising cases of this happy result are on record. It is true that the tonsils atrophy in later life, but this process is a prolonged

As will be noted by reference to the figure, its fenestra is oval in the vertical direction, while that of the Mackenzie instrument is round. Lennox Browne prefers the Mackenzie model with the fenestra oval in the horizontal direction and with an angular instead of a rounded cutting edge. The patient should be seated in a high-backed chair, behind which stands an assistant. The use of a mouth-gag is optional. The assist-

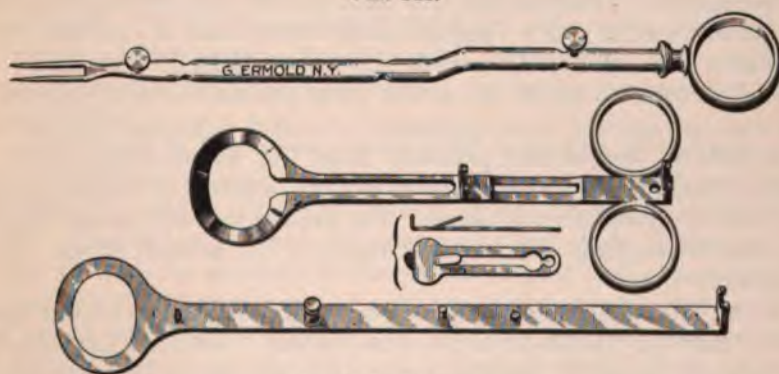
FIG. 210.



Mathieu's tonsillotome (Ermold model).

ant, firmly holding the patient's head, presses the tonsil in towards the median line of the mouth. The guillotine is then passed over the mass to be removed, pressed firmly against the side of the pharynx so as to make the tonsil project as much as possible through the fenestra, and the section is made. The employment of an anæsthetic in these cases is a matter of choice. If adenoids are to be removed at the same time, its use is most certainly advised, and the ideal agent is nitrous oxide gas,

FIG. 211.



Ermold's tonsillotome.

the administration of which will provide an anæsthesia lasting fully long enough for the removal of tonsils. If longer unconsciousness is desired it may be followed by a little ether. Chloroform is preferred by some, but if the double operation is to be performed it is not considered by the writer to be free from danger.

As concerns the use of cocaine in these cases of tonsillotomy, it must be remembered that the degree of anæsthesia by local application is very

slight. A vulsellum forceps can be used to lift the tonsil from its bed before section is made. Under these circumstances the patient can hold the tongue-depressor himself.

Ethyl bromide has been recommended as an anæsthetic in these operations. It has had an extended use on the Continent, but has not come into general employment in this country. The patient can be seated in a chair or, if a child, held in the lap of an assistant. The anæsthetic (from one-half to three-quarters of a fluidounce) is freely poured on an Esmarch inhaler and applied closely to the face. Anæsthesia is obtained in from thirty seconds to two minutes. The cornea becomes insensible, the eyes are generally open with some dilatation of the pupils, the face is congested, and the muscles are at first somewhat relaxed.

No positive rule can be given as to the age at which the liability to hemorrhage (see below) renders some method of removal other than by cutting advisable. Generally speaking, other methods are preferable after the patient has passed the twentieth year.

In case general anæsthesia is employed, the patient may lie on the side, with the head turned towards a strong light and on a plane slightly lower than that of the body. Under these circumstances the blood will readily run out from the corner of the mouth and may be caught in a basin. In any event, whether general anæsthesia is or is not employed, the patient should keep perfectly quiet for the next twenty-four hours, and children must, without exception, be kept in bed. All hot ingesta should be avoided, conversation prohibited, and all foods taken be soft and pultaceous. Crackers and dry toast should especially be forbidden. The patient should gently rinse the mouth every hour or two with a cold antiseptic solution, and ice-pellets may be freely used. Inspection will often show within a day or two a thin white pellicle over the cut surface; this may be regarded as an expression of a mild infection from the bacterial flora of the mouth, probably from the streptococci, which are always present. Mild febrile symptoms may ensue, but they are temporary and rarely require treatment. The exudate consists almost entirely of fibrin, leucocytes, and necrosed tissue of the surface of the wound (Harmer).

A. A. Bliss¹ has called attention to certain conditions of the tonsils which limit the usefulness of the tonsillotome. He notes that many of the patients presenting themselves for treatment do not show the typical form of tonsils as laid down in the text-books, and consequently that there are many in whom the use of the tonsillotome is impracticable. For the irregularly shaped and hard nodular though small tonsils he prefers, in place of this instrument, one which permits of a dissection of the parts to be excised from the surrounding tissues, a method of precision which does not leave the amount of tissue to be removed to the

¹ Jour. Am. Med. Assoc., March 12, 1898, p. 591.

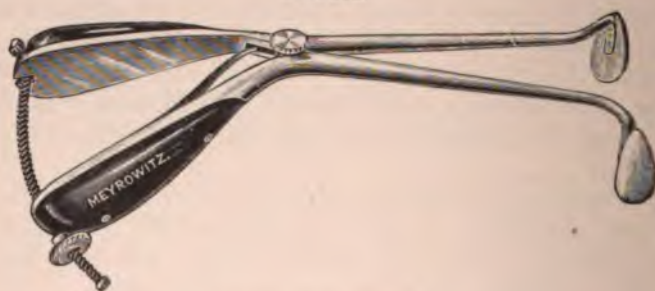
chance of engagement or non-engagement of the ring-knife. He finds the ideal instruments in a pair of crocodile-jaw forceps and scissors, the special features of the latter being long, powerful handles, relatively short, stout blades, and a socket into which the shank of the lower blade falls as the scissors close. This socket arrangement presses the blades together and prevents their springing apart when thickened tissue is severed. In proportion to the whole number of tonsillotomies, fatal bleeding must be rare. Under ordinary circumstances the gush of blood following section is considerable but temporary, ceasing in the course of a minute or two. Frequently the primary hemorrhage is trifling, while some hours or even days after a secondary bleeding may occur, which gives rise to the greatest anxiety, and the number in whom the bleeding has continued up to the point of fainting is considerable. This stage is, however, generally attended by such a lowering of the blood-pressure that the bleeding ceases, not to return.

Conditions favoring hemorrhage are hæmophilia, hardness of the tonsils leading to a canalization of the vessels after section, wounding of the anterior pillars, and an abnormal distribution of blood-vessels. It has been asserted that the submucous injection of cocaine, used as a local anæsthetic, may be responsible for some cases. The use of suprarenal extract for the exsanguination of the part is too recent to afford definite data. It should be remembered in this connection that while cocaine causes anæmia of a part by direct influence on the vasomotor apparatus, that of suprarenal extract is exerted upon the muscles in the walls of the blood-vessels. It will be seen that there are many cases in which the occurrence of hemorrhage cannot possibly be foreseen; the conditions favoring it may all apparently be wanting in a given case, and yet bleeding will follow.

A fatal result in a non-hæmophilic child is practically unheard of,—that is, where the faucial tonsils alone (and not the pharyngeal tonsil) have been removed. The vast majority of the cases have occurred in adults. The deduction from the statements just made is that no one should attempt the removal of the tonsil without being prepared for hemorrhage, for it may occur at any time; and, though the operator may be comforted by the thought that fatalities are very rare, he ought not to subject his patients to the debilitating effects which follow a severe loss of blood, and, moreover, he should have very clear ideas as to the course to be followed in case this complication arises. As Daly has said, any one who uses the guillotine on tonsils without reference to the condition of the organ and other attendant circumstances will some day meet his Waterloo. Once again special stress should be laid upon the routine after-treatment with reference to the character of the food and to abstinence from physical exertion. The practitioner who gives careful directions in these respects and insists upon literal obedience thereto will be far less liable to meet with accidents than the one who

dismisses his patient with a general exhortation to be careful what he eats and to keep quiet. If, however, bleeding does ensue, the tonsil should be most carefully examined and, if possible, the bleeding-point located. Bosworth finds the most common site of a spurting vessel at the junction of the lower third with the upper two-thirds of the cut surface. Torsion should first be used according to surgical rules, and if this fails, or if the bleeding occurs as an oozing from an extensive area, either pressure or cauterization may be exerted. Pressure may be applied by the thumb over the bleeding area and counter-pressure with the middle finger of the same hand on the outside of the neck at a point corresponding to the site of the tonsil. This measure will certainly check the bleeding, but the objection to it is that it requires to be kept up several hours in extreme cases and may provoke considerable retching on the part of the sufferer. If, however, it can be continued for a fairly long time, the clots forming in the mouths of the vessels will become sufficiently organized to remain in place after the pressure is removed. The use of the finger may be replaced by special instruments constructed on the general principle of substituting pads for the fingers, controlled by suitable spring pressure. The same likelihood of gagging, however, is seen here as with the fingers. As a type of instrument of this kind may be mentioned that of Butts (Fig. 212).

FIG. 212.



Butts's tonsillar haemostat.

Regarding the use of the cautery, it may be said that the skill of modern instrument-makers has led to the employment of either the galvano-cautery or the Paquelin instrument. The former has the disadvantage of being small, so that its heat is rapidly dissipated when applied to a bleeding surface of any considerable size. Where it is applicable, torsion is better. The Paquelin instrument, however, is so constructed that its heat can be maintained at any desired point. It should be heated up to a dull cherry-red. If this fails, the final resort is ligation of the carotid vessels, first the external, then, if necessary, the common, and finally the internal, but such extreme measures are rarely necessary. It may suffice to keep the mouth full of ice-pellets, or to use the

familiar combination of Morell Mackenzie (gallic acid, one part; tannic acid, three parts; water, four parts), which should be sipped slowly in full strength, and not used as a gargle. Chemical caustics do not find here a proper field of application. Especially should such preparations as Monsel's solution of iron be avoided. They are all uncertain, inefficient, and so obscure the field of operation by the formation of a pasty clot that subsequent manipulations are all the more difficult.

The possibility of bleeding from the use of cutting instruments has led to the substitution of various other means of section. One of these is the cold-wire snare. For this purpose may be used a snare constructed on the same general model as that employed for the removal of nasal polyps. It must be much stronger, however; in fact, large and strong enough to carry a No. 10 steel piano-wire. The instrument known as Farlow's meets all the requirements. Under its use the bleeding is usually of a trifling character, as the wire can be tightened so slowly that the vessels are occluded. The operation is extremely painful, and generally requires (always in children) the use of an anæsthetic. It has the advantage of allowing the careful adjustment of the wire, and if the pillars are

FIG. 213.



Farlow's tonsil snare.

separated so that the loop of the wire sinks deeply around the base of the tonsil, it is possible literally to remove the entire organ with its capsule.

The application of electricity in various forms may next be considered. It is, however, practically limited to the electro-cautery point or snare. The ease with which this agent may be controlled, the accuracy with which it may be applied, and the thoroughness of its effects have led to its replacing all of the old chemical cauterizing agents, such as chromic acid, silver nitrate, and the well-known London paste. The objection to all these and similar remedies is that they are relatively superficial in their action, so that many applications are required.

Concerning the application of the cautery point (the method of igni-puncture), it may be said that it is an ideal method for those cases in which the size of the tonsil is not great, where a cutting operation is objected to, and where there is a relation of the tonsillar tissue to surrounding structures which prevents the removal of the tonsil *en masse*. The operation is not especially painful, though many sensitive patients greatly complain of the smell of burning flesh, which they declare is far worse

sizes. The loop is shaped to adapt itself to the ring, to which it is fastened by a single thread at its distal extremity. The tonsil having been surrounded by the ring, traction is made on the loop, bringing it in contact with the tonsil above and below. At this instant the current is turned on, the thread holding the wire is burned through, the wire buries itself, and the further steps of the operation are simple. . . . The instrument should, of course, always be so applied as to carry the ring first over the base of the tonsil, the wire loop lying on its inner surface. . . . This method has two advantages. In the first place, there is no difficulty in putting the wire around the tonsil, and in the second place, the velum and the dorsum of the tongue are guarded by the steel ring, which remains perfectly cool."

CHRONIC ENCYSTED ABSCESS OF THE TONSILS.—This condition is responsible for certain cases of swelling in the tonsillar region. It may follow an acute suppuration, from the persistence of a cavity lined with a pyogenic membrane. If the cavity has an outlet through some of the lacunæ, the pus drains away as soon as it is formed, but if there is no such drainage, it may accumulate without acute symptoms or give rise to a repetition of the acute features. There seem, however, to be some abscesses which are chronic from the beginning. They are analogous in their mode of formation to the ordinary cold abscess, though they do not present any tubercular element. The encysted pus seems to be of a very low grade of virulence, and this is doubtless one factor in the chronicity of the condition. Most of the patients in reported cases have been young male adults. The pus-cavities are generally deep in the tonsillar tissue. The contents may be ordinary pus, but are more often of a grumous consistency, sometimes syrupy, or, if the condition is one of long standing, fatty, like the contents of a sebaceous cyst. The individual pus-cells are fatty and granular, and contain cholesterin crystals. The cavity-wall is of a low grade of connective tissue, organized at the expense of the surrounding tonsillar parenchyma. Bacteriologically, the sac contents are like those of abscesses in general. In one of Peyrissac's cases the staphylococcus albus was isolated.

Symptoms.—The symptoms are practically those of simple hypertrophy. There are no acute manifestations, but an intermittent purulent discharge may suggest the cause of the tonsillar prominence. Recent cases may give a feeling of fluctuation, while those of long standing are hard, even like fibromata. The exploring needle may be used in cases of doubt.

Treatment.—If possible, the whole tonsil should be excised with the guillotine or galvano-cautery snare. The abscess-cavity is thus laid bare, and its walls should be thoroughly curetted. A solution of zinc chloride, forty grains to the ounce, to which a little cocaine has been added, is then well rubbed over the curetted surface.

CHRONIC ENLARGEMENT OF THE LINGUAL TONSIL.—The nature of this condition has been sufficiently outlined in preceding pages. It

may occur in connection with enlargement of the faucial structures, or exist alone. It is more common at the middle period of life, a time when the other tonsillar deposits have generally atrophied. In the experience of the writer, it is more common in women. The symptoms are the same as those of the acute variety, except in degree. There are the constant feeling as of a foreign body, various pharyngeal dysæsthesiæ, spasm of the œsophagus, sometimes globus hystericus, and frequently an impairment of vocal clearness and endurance. Perhaps the most common symptom of all is an annoying, dry, irritating cough, which is often worse at night. Examination of the chest fails to reveal any abnormality of the lungs, and the cause of the cough is not determined until the region of the lingual tonsil is examined.

FIG. 217.

Hypertrophy of the lingual tonsil.
(McBride.)

FIG. 218.



Hypertrophy of the lingual tonsil. (Selfert and Kahn.)

Treatment consists in the removal of the offending tissue. A wire snare in a curved canula, the wire being either hot or cold, may be used

to remove the offending masses, or they may be taken off with a lingual tonsillotome (Fig. 219).

In case the masses are not large enough to engage in any of the foregoing instruments, the ignipuncture method may be used (page 567).

FIG. 219.



Myles's lingual tonsillotome.

Care must be taken not to burn too freely in this locality, for the production of too much scar tissue may predispose to later neoplastic formation.

POLYPOID HYPERTROPHY OF THE TONSILS.—Apart from hypertrophy of the tonsil as a whole, sometimes there is found a local enlargement, giving rise in a lesser degree to the same symptoms as general

hypertrophy, and remediable by the same measures, especially the galvano-cautery snare, as the growths are more or less pedunculated. In these adjunct masses there is generally an excessive development of connective tissue, which at times resembles an actual sclerosis. Such growths may be accessory tonsils, or may present as an elongation at the site of attachment of one or several lobules of a multilobular and hypertrophied tonsil. Occasionally the entire tonsil is pedunculated. A marked example of this condition is that reported by Lemariey¹ (Fig. 220). In his case the length of the pedicle was sufficient to give rise to symptoms of suffocation. In some

FIG. 220.



Polypoid hypertrophy of the tonsil. (Lemariey.)

of the reported cases evidences of a tubercular tendency were noted, but these were doubtless accidental. Some of the masses may have been pure fibromata. Lemariey's case presented as its characteristic histological features submucous plaques of fibrous tissue, and, entirely apart from these, perivascular deposits of the same nature. According to Hajek, some of the masses take their origin

¹ Ann. des Mal. de l'Oreille, 1895, vol. xxi. p. 452.

from the strangulation of a portion of adenoid tissue, while others are an elongation of the point of insertion of an accessory tonsil. There would appear to be no reason why, at any point in the ring of Waldeyer, the lymphoid elements should not take on an abnormally large development, and if such excess of growth is at a point where the action of muscular structures would tend to stretch it, the mode of polyp formation is easily understood.

FOREIGN BODIES IN THE TONSILS.—Under this heading are included parasites, calculi, and deposits of bone or cartilage. Foreign bodies are mostly sharp or slender substances, such as fish-bones, pins, and bristles from tooth-brushes. Morell Mackenzie has called attention to the fact that some patients are especially liable to this accident, which may come from improper mastication of food, irregularities of structure, or defective sensibility of the mucosa. The symptoms are a pricking and stinging pain, aggravated on movement. Mere inspection may fail to locate the body, but careful palpation will generally determine its exact position. At times the body may migrate through the tonsillar tissue, and so for a time escape detection. Incision into the tonsil may be necessary here, but when once the body is found its extraction with forceps of various kinds is an easy matter.

TONSILLAR CALCULI.—These may occur in any part of the tonsils or in the faucial pillars. Goodale¹ has reported a unique case of calculus occurring in the uvula of a colored child two months old. The mass caused symptoms of suffocation, but was easily enucleated with cutting forceps. Several years ago C. A. Parker² removed a calculus from the right side of the palate. The site looked like an ulcerated surface, while the surrounding tissues were hard and inflamed. Calculi in this general region probably originate in the accumulation of cheesy matter in the crypts of the mucosa. Most of this accumulation is squeezed out by the movements of the jaw in mastication. If for any reason a portion becomes impacted in a crypt, it may become the seat of calcareous deposits. The nucleus is apt to be a foreign body, especially the lepto-thrix, which seems to predispose to cheesy deposits. These irritating masses often set up inflammation.

The symptoms of these calculi are those of a foreign body, while the hardness may be suggestive of a malignant growth. Exploration with a needle will reveal the nature of the mass. Treatment consists in an incision over the most prominent part, turning the calculus out of its bed, and thoroughly cauterizing the latter. In one instance, quoted by Bosworth, Anselmier, finding calcareous matter in a palatal recess, passed into the latter a tampon saturated with a weak solution of sulphuric acid, and dissolved out the offending material.

¹ Boston Med. and Surg. Jour., December 8, 1898.

² Trans. London Path. Soc., December 15, 1893.

BONY AND CARTILAGINOUS GROWTHS IN THE TONSILS.—Several instances of this condition have been reported during the last few years. Hugh Walsam¹ has found small masses of cartilage occurring as trabeculae, rings, or nodules. He is convinced of the close analogy between these masses and those small cartilaginous deposits which develop in the course of the branchial clefts in the neighborhood of the ear or sometimes lower down in the neck. He thinks that they are derived from the second branchial arch, and are, therefore, to be looked on as foetal remnants. For reasons unknown, in after-life these nodules may take on growth and proliferation. Distinctly bony trabeculae have been found mainly in persons well advanced in years. Under such conditions they might be considered as senile changes; but bone has also been found at as early an age as two years, and it is therefore probable that there are from the first potential centres of ossification. Kanthack dissents from the view above expressed as to origin, and believes the nodules to be not the result of embryonic inclusion, but merely a metaplasia of fibrous tissue into bone or cartilage.

Stirling² has approached the subject from a somewhat different point of view in his report of three cases. His first case was that of a girl, who complained of pain in the right tonsil radiating to the right nasal bone, mastoid, eye, and shoulder. Caseous masses had been pressed from the tonsil, and the force required in doing this had caused intense pain. Palpation showed a hard mass extending from behind and underneath the tonsil to the level of its anterior surface; the mass appeared rounded and pointed. In front the finger could be laid in the angle between the mass and the maxilla, while behind it there was another angle between the tumor and the right side of the vertebral column. The tonsil itself was somewhat enlarged.

Wingrave³ has seen several specimens of cartilaginous deposits in tonsils generally the seat of chronic hypertrophy. Sometimes they have been located in a fibrous bed and sometimes in the lymphoid pulp, but never in the lymph-follicles or nodules. Calcareous deposits were found, but never osseous. This author thinks that as "vestigial rests" they may possibly be the foci of neoplastic formations and deserve closer study than has thus far been given them. He adds the practical observation that their occurrence may explain the feeling of resistance occasionally noticed in section of the tonsil with the guillotine.

XEROSTOMIA (DRY MOUTH).—This is a rare condition of the mouth, in which the tongue is red, cracked, and dry; the buccal surface of the cheeks and the hard and soft palates are also dry, and the mucosa becomes pale, smooth, and glistening. Speech is difficult, as is also swallowing.

¹ London Lancet, August 13, 1898, p. 534.

² Jour. Am. Med. Assoc., 1896, p. 743.

³ London Lancet, 1898, vol. ii. p. 750.

There appears to be no constant pathological condition of the salivary glands. The disease usually occurs after middle life, and, outside of the two cases reported in men by Seifert, is seen in women.

Of the cases reported, three had a sudden beginning, two of them having had a severe mental shock; another case occurred in an hysterical woman who had anuria, while a fifth patient was very hypochondriacal. The tongue is often cracked, like alligator skin. On its anterior part papillæ are often wanting, but the circumvallate papillæ are preserved. Common sensation is unimpaired, but, owing to the dryness, that of taste is weakened or entirely lost; at the same time, dryness of the nasal and lachrymal apparatus may be noticed. The disease usually reaches its maximum intensity in a short time, and may then remain stationary for years. In some instances dryness of the skin and falling out of the teeth have been observed. Urinary examination has shown nothing. In some cases the parotid glands are enlarged.

No satisfactory explanation has yet been found for this curious condition. The symptoms suggest a trophoneurosis,—some affection of a nervous centre (still hypothetical) controlling the secretion of all the buccal and salivary glands. Only about twenty cases have been recorded.

Treatment.—Pilocarpine and the potassium salts have been given with the idea of increasing secretion, but without definite effect. Glycerin applications have afforded some relief to the uncomfortable dryness of the mouth.

DISEASES OF THE LARYNX.

CHAPTER XI.

ANATOMY AND PHYSIOLOGY OF THE LARYNX.

THE larynx may be considered as a cartilaginous box with incomplete sides opening above into the pharynx and below into the trachea. Placed at the upper and fore part of the neck, it forms a considerable prominence, known as the *pomum Adami* or Adam's apple, more prominent in men than in women. It lies between the large cervical vessels, and below the level of the tongue and the hyoid bone. Its anterior boundaries are along the middle line, skin, and cervical fascia; on each side are the sternothyroid and thyrohyoid muscles, the upper end of the lateral lobe of the thyroid gland, and a small portion of the inferior constrictor muscle of the pharynx. Posteriorly, the prævertebral muscles and the laryngopharynx intervene between it and the fourth, fifth, and sixth cervical vertebræ.

From the measurement of a small number of cases Sappey gives its dimensions as follows: height, from the upper border of the thyroid cartilage to the lower border of the cricoid, forty-four millimetres in men and thirty-six millimetres in women; breadth, or distance between the posterior borders of the thyroid cartilage, forty-three millimetres in men and forty-one millimetres in women; antero-posterior distance from the most prominent point of the anterior thyroid border to a line uniting its posterior borders, thirty-six millimetres in men and twenty-six millimetres in women.

The component parts of the cartilaginous box present various articulations and are united by elastic membranes or by ligaments. The tension of the latter is modified by the action of various muscles, which also move the cartilages on one another. The mucous lining of the box is continuous above with that of the pharynx and below with that of the trachea.

Cartilages.—The cartilages may be divided into two groups,—those occurring singly and those occurring in pairs. Of the single cartilages, the largest and most prominent is the thyroid (shield), which consists of two flat plates united in front at an angle of about ninety degrees, like the letter V. At the top this junction is prominent and subcutaneous, forming the Adam's apple. The plates are approximately quadrilateral. The anterior border is the shortest, forming with its fellow the deep thyroid notch. The posterior border is thickened and vertical, being pro-

longed above and below into processes called cornua, or horns. Attached to it are the stylopharyngeus and palatopharyngeus muscles. The upper and lower borders have each a deep concavity close to the cornua; otherwise, the top border is convex and the bottom nearly straight. The external surface of each plate, or ala, is flattened, and has near the posterior part of the upper border a superior and at the lower border an inferior tubercle. Between these two passes an oblique ridge separating the anterior three-fourths of the surface from the posterior fourth. This ridge gives attachment to the thyrohyoid muscle, and below to the sternothyroid; the smooth surface behind it, to a part of the inferior constrictor of the pharynx.

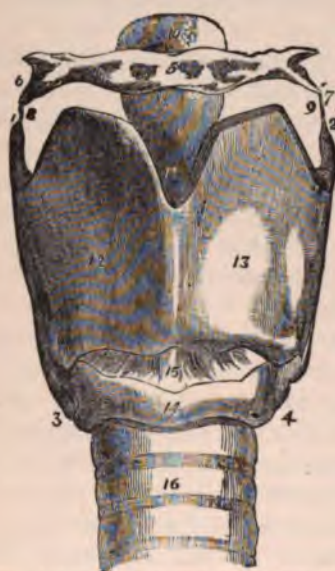
On their internal surfaces the alæ are slightly concave and perfectly smooth. The superior cornua pass upward and slightly backward and inward, each terminating in a blunt extremity, which is attached by means of the lateral thyrohyoid ligament to the greater cornu of the hyoid bone. The inferior cornua are directed slightly forward, and show on the inner aspect of their tips a blunt facet, for articulation with the cricoid cartilage. Quain calls attention to the fact that occasionally an abnormal branch of the superior laryngeal artery penetrates the thyroid ala near the upper part of its posterior border.

The cricoid cartilage (signet-ring) is deep behind, where it presents a quadrilateral surface, with a vertical measurement of about one inch, but in front its vertical measurement is only about one-quarter as great. A cross-section is circular at the lower border, but elliptical higher up. The inferior border is flat, resting on the trachea, to which it is united by membrane. The superior border, markedly elevated behind, tapers off rapidly towards the front, presenting a deep concavity below the thyroid cartilage. The posterior upper border has a median depression, with lateral facets for articulation with the arytenoid cartilages; these facets face outward and upward, and are slightly convex. In front and at the sides the external surface of the cartilage is smooth, giving attachment to the cricothyroid muscle. In the middle of the posterior surface is a ridge, to which are attached some of the muscular fibres of the œsophagus. Lateral to this ridge, on either side, is a broad hollow for the posterior crico-arytenoid muscle. Outside the attachment of the latter is the articulation with the inferior cornu of the thyroid cartilage. The internal surface is smooth, being lined by the laryngeal mucosa.

The epiglottis is a yellow cartilaginous lamina, obovate in shape, covered by mucosa, lying in front of the upper laryngeal opening, and usually projecting upward behind the base of the tongue. Broad and rounder at its upper free margin, it is pointed and tongue-like below, and by means of the thyro-epiglottic ligament is attached to the re-entrant angle of the thyroid alæ a little below the median notch. Its lateral convex borders are enveloped below in the folds of the aryteno-epiglottidean folds of mucosa. Anteriorly, its surface is free above, but below the mucosa is

reflected forward to the tongue, forming the median and lateral glosso-epiglottic folds. Below, a median elastic fold (hyo-epiglottic ligament) connects it with the posterior surface of the hyoid bone. The posterior surface is entirely free, concavo-convex from above downward, but concave from side to side. The convexity fits down, so to speak, into the entrance of the laryngeal cavity, and is spoken of as the cushion or tubercle of the epiglottis. The cartilage is covered with mucosa, the

FIG. 221.



Front view of the larynx, thyroid cartilage in position. (Browne.) 1, 2, superior cornua of thyroid; 3, 4, inferior cornua of thyroid; 5, hyoid bone; 6, 7, cornua of hyoid bone; 8, 9, thyro-hyoid ligament; 10, 11, epiglottis; 12, 13, alae of thyroid cartilage; 14, cricoid cartilage; 15, cricoid membrane; 16, trachea.

FIG. 222.



Side view of the larynx. (Browne.) 1, prominence of thyroid cartilage (*pomum Adami*); 2, cricoid cartilage; 3, 4, upper border of cricoid cartilage; 5, 6, lower border of cricoid cartilage; 7, thyroid cartilage; 8, 9, superior cornua of thyroid cartilage; 10, right inferior cornu of thyroid cartilage; 11, articulation of thyroid cartilage with cricoid cartilage; 12, cricothyroid aperture; 13, epiglottis; 14, trachea.

removal of which shows minute depressions, lodging the mucous glands opening on the surface.

Of the paired cartilages, the most prominent are the arytenoid (shaped like the lips of a pitcher), symmetrical in form and position. They are irregular, triangular pyramids, resting by their bases on the upper posterior part of the cricoid, while their apices, somewhat incurvated, approximate. They are about one-quarter of an inch wide and half an inch high. The posterior surface is broad and triangular, concave from above downward, lodging a portion of the arytenoideus muscle. The anterior (external) surface presents a transverse ridge at the junction of its mid-

dle and lower thirds. Above and below this are concavities. Near the inner end of the ridge is inserted the false vocal band, and at its outer portion and in the adjacent hollows is attached the thyro-arytenoideus muscle. The narrow internal surface, parallel with that of the opposite cartilage, is covered with mucosa. The anterior and posterior borders of this latter surface are nearly vertical, while the external border separating the anterior from the posterior surface is oblique. The base of each arytenoid is concave, having towards its outer part a facet for articulation with the cricoid cartilage, on which it rests.

It remains to speak of the angles. The external is short and rounded,

FIG. 223.



Side view of the larynx, showing the interior, the right plate of the thyroid cartilage being removed. (Browne.) 1, 2, arytenoid cartilages; 3, 3, vocal processes of the arytenoids; 4, muscular process of the right arytenoid; 5, upper border of cricoid cartilage; 6, 3, 3, vocal bands; 7, facet for articulation with the lesser horn of the thyroid cartilage; 8, left plate of thyroid; 9, left superior horn of the thyroid cartilage; 10, cricoid cartilage; 11, trachea.

FIG. 224.



The cricoid cartilage, the arytenoid cartilages, and the cartilages of Santorini. (H. Allen.) The structures last named have been called *cornicula laryngis*. a, cornicula laryngis; b, vocal process; c, attachment of crico-arytenoid, posticus and lateralis; d, arytenoid.

extending backward and outward from the plane of the base, and giving insertion to the lateral and posterior crico-arytenoid muscles, hence called the muscular process. The anterior vocal process, pointed in a horizontal position, gives attachment to the true vocal cord.

Surmounting the curved apices of the arytenoids are the cartilages of Santorini, or cornicula laryngis, two small yellowish nodules, conical in shape, articulating with the summits of the arytenoids and prolonging them backward and inward.

The cartilages of Wrisberg, or the cuneiform cartilages, are situated one on each side in the fold of mucosa which reaches from the summits of the arytenoids to the epiglottis. They are small, yellowish, conical in

shape, with the base directed upward, and appear in the laryngeal image simply as elevations of the mucosa.

The cricoid and thyroid, with the bottom part of the arytenoid, are composed of ordinary hyaline cartilage, and in later years ossify more or less, while the epiglottis, the cornicula, and the cuneiform cartilages are composed of yellow fibrous or elastic cartilage, and show no tendency to ossify.

Marked changes occur in the larynx at the age of puberty. In the later months of foetal life the organ is fully the width of two vertebrae higher than in the adult. Descent begins just before birth, and the adult position is reached at puberty. Up to the latter period no change is discernible between the male and female organs, but at this time the female larynx increases in size, and this is the only notable alteration. The male larynx, however, not only increases in size, but becomes as a whole more prominent and visible at the upper part of the neck. All the cartilages become stronger, the angle of junction of the thyroid *alæ* more prominent, and the notch between them deepened. The effect of this is to lengthen the distance between their inner angle and the arytenoids, with a consequent lengthening of the vocal cords. Ossification begins in the cartilages about the twentieth year.

From a developmental point of view, the thyroid represents the ventral remains of the skeletons of the fourth and fifth pairs of visceral arches, united by a median plate, represented in turn by the union of the *alæ*. The cornua, or processes, of each *ala* represent the ununited parts of the two arches. The development of the other cartilages is variously described. According to E. Dubois,¹ the epiglottis represents a chondrification in the submucosa of the glossolaryngeal fold. In a similar manner the cartilages of Wrisberg are formed in the false cords. Gegenbauer² holds that the epiglottis is an independent element of the body derived from the sixth pair of visceral arches, while, according to Goppert,³ the cartilages of Wrisberg are formed from the lateral processes of the primitive epiglottis.

Ligaments.—The next point to be considered is that of the membranous and ligamentous attachments of the various parts of the larynx. Above, the organ is connected with the hyoid bone by the thyrohyoid membrane, or middle ligament (Figs. 225 and 226), which is attached below to the entire upper border of the thyroid, and inserted above at the posterior and upper margin of the inferior surface of the hyoid, which is obliquely inclined. In consequence of this the larynx will slip, when drawn up in the act of swallowing, within the ring of the hyoid bone. In the median line the membrane is quite thick, but on each side, where it is covered by the thyrohyoid muscles, it thins out, and is perforated by the superior

¹ *Anatom. Anzeiger*, 1886.

² *Kölliker's Festschrift*, 1892.

³ *Morph. Jahrb.*, 1894, Bd. xxvi.

laryngeal artery and nerve. At the posterior border on each side of the membrane a lateral thyrohyoid ligament (distinctly elastic) passes from the upper cornu of the thyroid to the extremities of the greater cornu of the hyoid.

The connection between the thyroid and cricoid is partly membranous and partly articular. The median portion of the cricothyroid membrane, broader below than above, is a yellowish, elastic ligament, uniting the adjoining borders of the two cartilages. In front, it is nearly covered in by the cricothyroid muscles, while across it runs an anastomotic twig

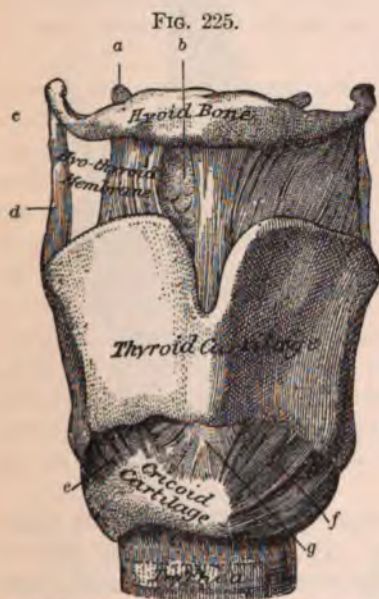


Fig. 225.
The hyoid bone and larynx, with ligaments, seen from in front. (H. Allen.) *a*, lesser horn; *b*, fat beneath thyrohyoid membrane; *c*, great horn; *d*, lateral thyrohyoid ligament; *e*, cricothyroid (deep portion); *f*, cricothyroid (superficial portion); *g*, cricothyroid membrane.

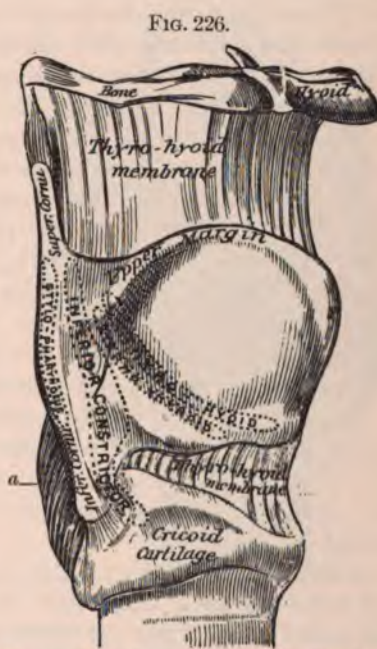


Fig. 226.
The same, seen from the side. (H. Allen.) *a*, capsular ligament.

between the cricothyroid branches of the superior thyroid arteries. The lateral portions of the mem-

brane become much thinner above, where they are continuous with the inferior thyro-arytenoid ligaments.

Between each inferior cornu of the thyroid and adjoining side of the cricoid is a distinct joint with a capsular ligament lined with synovial membrane. The axis of this joint passes transversely, so that the movement is practically one of pure rotation, though there may be a slight gliding forward and backward.

Of the thyro-arytenoid ligaments there are two pairs,—superior and inferior. The former, consisting of a few delicate fibrous strands in the

fold of mucosa, are known as the false vocal cords, or ventricular bands. They are attached in front to the angle between the alæ, just above its middle, and close to the attachment of the epiglottis; behind, to the inner part of the ridges on the anterior surface of the arytenoids. The inferior pair are attached in front similarly to the superior, but lower down. Posteriorly, they are inserted into the anterior projection of the base of the arytenoid cartilage. Their sharply defined inner edges, covered by mucous membrane, form on each side the true vocal cords, but in other directions the limits of the ligaments are less sharply defined. Above, the fibres of each ligament lie near the upper surface of the projecting fold of mucous membrane bounding the rima glottidis, becoming merged into the elastic tissue of that membrane. Below, there is a gradual union with the lateral cricothyroid ligament, of which the ligament may be described as an upward extension.

The crico-arytenoid articulations have a ligamentous capsule, with synovial membrane. The facets of the arytenoids are concave and those of the cricoid convex. The movement at this joint is a double one:

first, a rotation around the nearly perpendicular axis, and, second, a lateral gliding in and out, the arytenoid leaving or approaching its fellow. There may be a combination of the two movements, a point to be well considered in attempting to account for some of the peculiar positions of the cartilages seen in laryngeal paralyses. It should be remembered that under normal conditions, when the larynx is at rest,

the arytenoid rests on the outer part of the articular surface of the cricoid.



The rima glottidis, a. (H. Allen.)

Internally, the larynx is divided by the rima glottidis into an upper and lower chamber (Figs. 228 and 229). The margins of the anterior two-thirds of the rima are formed by the edges of the true vocal cords. The upper chamber is sometimes called the "vestibule," communicating with the pharynx above. Immediately above the rima lie the ventricles, and still higher, the false vocal cords. Below the rima the lining of the larynx is continuous with that of the trachea, without any sharp line of demarcation between the two.

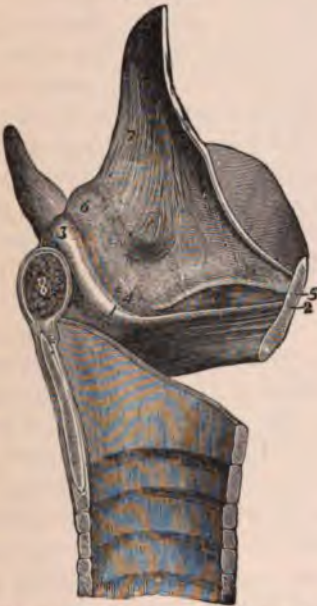
The upper aperture of the larynx is, when open, wide in front and narrow behind, being triangular. The anterior and posterior boundaries are respectively the epiglottis and the summits of the arytenoid cartilages. At the sides are the aryteno-epiglottidean folds, passing from the tips of the arytenoids to the sides of the epiglottis. In these folds are the Wrisberg cartilages and a few fibres. The mucosa covering the true cords is thin, which causes them to appear yellowish or, more often, pearly gray or pink.

The rima is divided into an anterior, or vocal, and a posterior, or

respiratory, portion. In easy respiration, when it is moderately open, it has the shape of a triangle, with its base posteriorly; in a condition of full dilatation it becomes lozenge-shaped. The rima measures in men about twenty-three millimetres in length and from six to eight millimetres across in its widest part, which can be dilated to nearly double that distance; in women the measurements are about one-third less. The length of the vocal cords themselves is about fifteen millimetres in men and eleven millimetres in women.

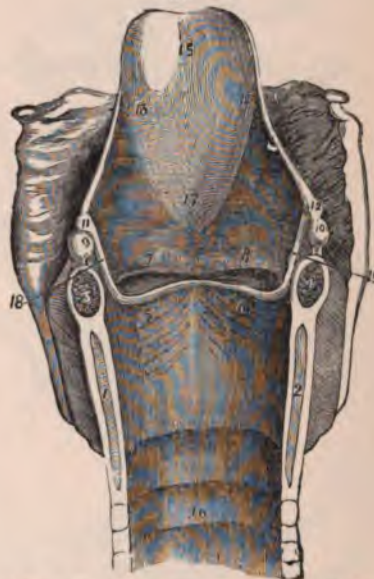
The ventricles, or sinuses of the larynx, are situated between the false

FIG. 228.



Side view of the larynx, showing the left ventricle of Morgagni, left epiglottic ligament, etc. (Browne.) 1, 2, left vocal band; 3, elevation indicating the site of the left cartilage of Santorini; 4, 5, left ventricular band, false vocal band; 5, 4, 2, 1, entrance to left ventricle of Morgagni; 6, elevation indicating the site of the left cartilage of Wrisberg; 7, aryteno-epiglottidean (aryepiglottic) ligament; 8, arytenoid muscle.

FIG. 229.



View of the larynx opened from behind. (Browne.) 1, 2, cricoid cartilage; 3, 4, arytenoid muscle; 5, 6, vocal bands; 5, 7, 6, 8, entrance to the ventricles of Morgagni; 7, 8, ventricular bands, superior thyro-arytenoid ligaments; 9, 10, cartilages of Santorini; 11, 12, cartilages of Wrisberg; 11, 12, 13, 14, aryteno-epiglottidean (aryepiglottic) ligaments; 15, epiglottis; 16, trachea; 17, cushion of epiglottis; 18, 19, cuneiform cartilages.

and true cords. From their anterior part there is an upward prolongation known as the sacculus laryngis, or pouch of the larynx. It runs up for about half an inch between the false cord and the thyroid cartilage, being covered on its outer surface by the fibres of the thyro-arytenoid muscle. Each pouch is abundantly supplied with glands and nerve-twigs from the superior laryngeal. The arrangement of the mus-

cular fibres about the pouch is such that their contraction easily serves to empty it.

The laryngeal mucosa is, as a rule, thin and closely attached to the neighboring parts. About the aryteno-epiglottidean folds it has much subjacent loose areolar tissue, conducive to copious inflammatory exudation. As a rule, the mucosa is ciliated, though on the true cords themselves it is of the stratified variety. The same condition obtains from a level slightly above the false cords at the sides and the middle of the epiglottis in front.

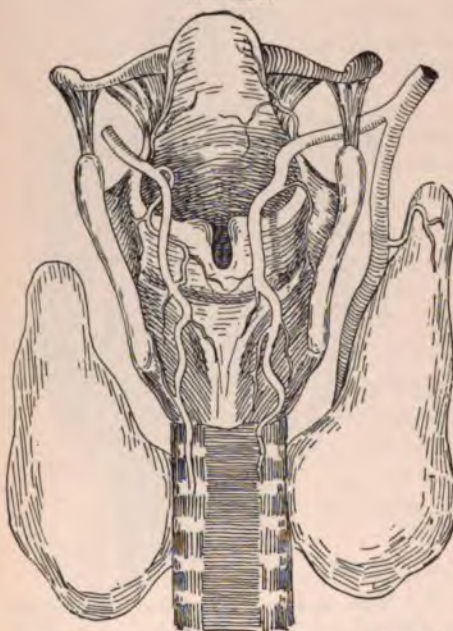
The arteries (Figs. 230 and 231) come from the superior thyroid

branch of the external carotid and the inferior thyroid from the subclavian. The veins join the superior, middle, and inferior thyroid groups. There are upper and lower lymphatics, the former piercing the thyrohyoid membrane and the latter the cricothyroid. The former lead to glands near the carotid bifurcation.

The nerve-supply (Fig. 232) is from the pneumogastric, by means of the superior laryngeal, to the entire mucosa, the cricothyroid muscle, and, in part, the arytenoid muscle, bearing thus in its trunk both motor and sensory fibres. The inferior laryngeal nerve supplies all the muscles except those named above, and in part the arytenoid.

Muscles of the Larynx.—The muscular supply of the larynx may be studied from various

Arterial supply of the larynx, posterior view, showing the distribution of the superior laryngeal artery. (Bosworth.)



stand-points. As some of the muscles have more than a single function, it is hard to divide them into groups. Attention is therefore called to them in order, the function or functions of each being stated.

Two muscles not strictly belonging to the larynx may be mentioned here, as, by their action on the organ as a whole, they play an important part in voice-formation. These are the sternothyroid and thyrohyoid. The sternothyroid arises from the upper thoracic surface of the sternum, and is inserted into the oblique line on the ala of the thyroid cartilage. The thyrohyoid is practically an upward continuation of the former, arising from the oblique line on the ala of the thyroid and being in-

served into the lower border of the body and greater cornu of the hyoid bone near their junction. The contraction of the former tends to lift and that of the latter to depress the cartilaginous box of the larynx. The resulting combined action firmly fixes the larynx against structures behind, so as to allow of a more perfect action of the muscles which do not connect with external parts. Other muscles also contribute, though to a less degree, to this steadying action.

Of the intrinsic muscles, there is first the cricothyroid (Fig. 233) or, better, on the principle of using in a combined name the first part to indicate the fixed and the second to indicate the movable portion of the structures acted on, the thyrocricoid. It is attached above to the inferior border of the thyroid cartilage and to the anterior border of its inferior cornu. Below, it is attached to the cricoid cartilage from the median line, a considerable way back, its fibres passing upward and outward, slightly diverging. The thyroid cartilage being fixed by the action of the extrinsic muscles just described, the action of the thyrocricoid will be to draw the cricoid cartilage up and back, thus rendering the vocal cords tense.

The posterior crico-arytenoid muscle arises from the broad depression on each side of the median line of the posterior surface of the arytenoid cartilage, and its converging fibres pass upward and outward, being inserted into the outer angle of the base of the arytenoid cartilage behind the attachment of the lateral muscle of the same (Fig. 234). The outer or more horizontal fibres of the former tend to draw each cartilage from its fellow, while the inner or lower fibres rotate it on its base, the outer angles of the cartilages being rotated backward and outward, thus throwing directly outward the anterior or vocal processes to which are attached the vocal cords. The rima glottidis is thus widened.

The lateral crico-arytenoid runs along the upper sloping border of the cricoid cartilage, the origin extending along this border as far back as the articular surface for the arytenoid. It is thus concealed in great measure by the ala of the thyroid. Its fibres pass up and back to be inserted into

FIG. 231.

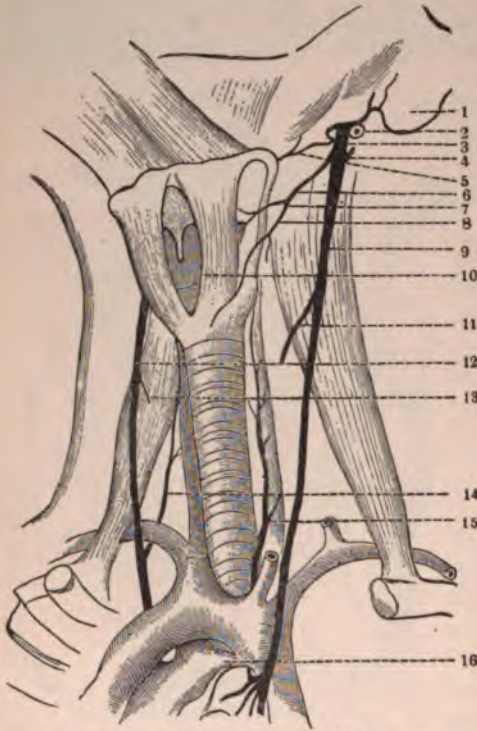


Arterial supply of the larynx, anterior view, showing the distribution of the inferior laryngeal artery. (Bosworth.)

the muscular process of the arytenoid. This action of this muscle is to rotate the arytenoid cartilage so as to bring its vocal process towards the median line, thus narrowing the rima glottidis.

It should be borne in mind that the movement of the cricoid on the

FIG. 232.



Course of the laryngeal branches of the vagus nerve in the new-born. (Henle.) 1, mastoid process; 2, jugular vein, severed; 3, plexus gangliiformis; 4, internal branch of the accessory nerve; 5, pharyngeal branches of the vagus uniting with the pharyngeal branch of the glossopharyngeal nerve; 6, superior laryngeal nerve; 7, internal branch of the superior laryngeal nerve; 8, external branch of the superior laryngeal nerve; 9, left vagus nerve; 10, thyrohyoid muscle; 11, cardiac branch of the left vagus nerve; 12, right vagus nerve; 13, cardiac branch of the right vagus nerve; 14, right recurrent nerve; 15, left recurrent nerve; 16, ductus arteriosus Botallus.

FIG. 233.



Side view of the larynx, showing right cricothyroid muscle. (Browne.) 1, 2, 1 cricothyroid muscle; 4, right inferior cornu of thyroid; 5, thyroid cartilage; 6, 7, superior cornu of thyroid; 8, epiglottis; 9, trachea.

is a seesaw one, the arytenoids rocking outward and inward. A dissected larynx dispenses with the action of the extrinsic muscles, and, owing to the complicated structure and musculature of the larynx, any

arytenoid is not one of mere rotation. Bonnier¹ has carefully studied this matter, saying that physical experiments upon a dissected larynx can never imitate the normal action of phonation. The arytenoids, he says, do not pivot on the cricoid around a vertical axis. The true movement

¹ Arch. Internat. de Laryngol., 1898, vol. xi. p. 339.

physiological movement is a resultant of complicated muscular action, for the various parts to which the muscles are attached are always playing on one another. In order to maintain the mutual relation of the cricoid and thyroid during phonation, the thyroid is raised by the elevators of the larynx to prevent tilting. By this is meant the changing of the relative position of anterior and posterior insertions of the vocal cords.

If the patient sighs,—that is, closes the glottis without phonation,—this movement of rocking can easily be appreciated. The typical picture observed in phonation is that of adduction of the vocal cords to a position

FIG. 234.



Muscles of the larynx, seen from behind. (Browne.) 1, 2, cricoid cartilage; 3, 4, arytenoid muscle; 5, 6, thyroid cartilage; 7, 8, hyoid bone; 9, 12, cartilages of Santorini; 10, 13, cartilages of Wrisberg; 11, 14, 15, epiglottis; 16, trachea; 17, thicker (cushion) portion of the epiglottis; 18, 19, posterior crico-arytenoid muscles; 20, 21, 22, 23, arytenoid.

FIG. 235.



Side view of the larynx, showing interior of the left half. (Browne.) 1, 2, 3, 4, left vocal band and thyro-arytenoid muscle; 5, left arytenoid cartilage; 6, 7, cricoid cartilage; 5, 7, lateral crico-arytenoid muscle.

nearly that of effort, but not quite, however, for there is no actual contact of either true or false cords. The latter leave the former visible between them, and the former are sufficiently apart to reveal the existence of a glottic aperture. The more acute and intense the sound the greater is the closure of the interarytenoid portion of the rima glottidis.

The *thyro-arytenoid* muscle consists of two portions, one lying just within the ala of the thyroid and the other, more internal, in contact with the vocal cord. Attachment in front is in the receding angle of the thyroid. The internal portion is attached to the whole length of the vocal cord, being inserted behind in the vocal process of the arytenoid,

while the external, spreading out more widely, is inserted in the anterior surface of the arytenoid. The external portion relaxes the cords, while the internal portion approximates their edges in the production of some of the finer notes. The complicated action of this muscle arises from the fact that many of its fibres do not extend through its whole length, but have subsidiary origins and insertions apart from those of the fibres which make up the muscle as a whole; some of these local fibres may serve to modify the elasticity and consistence of the cord, while others may tighten the segments of the cords in front of their attachment and slacken those behind.

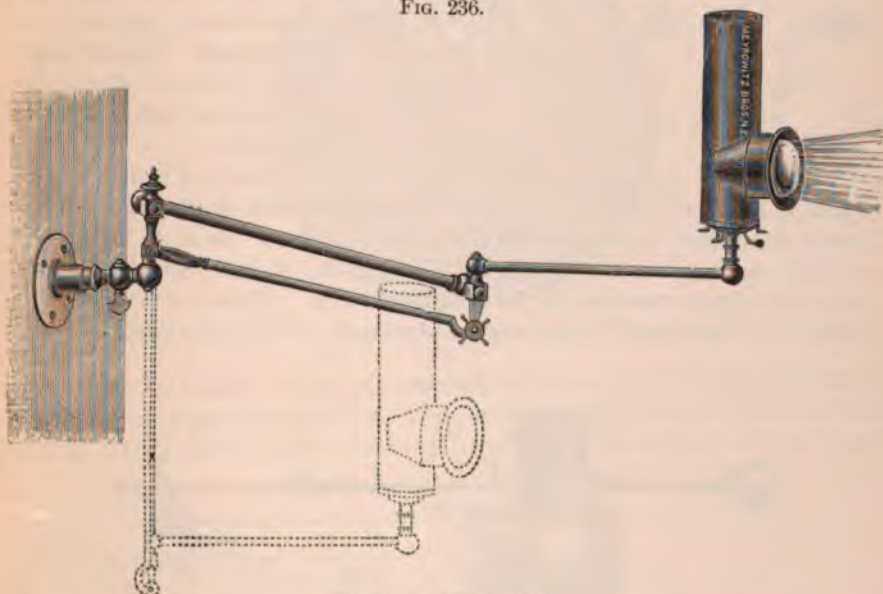
The *arytenoid* muscle is a square bundle attached to the posterior concave aspects of the arytenoid cartilages (Fig. 234). Most of the anterior fibres are transverse and extend directly across to be attached to the outer half of the concave surface of the opposite cartilage. The more posterior or dorsal fibres are inserted variously in the lateral laryngeal walls, while the intermediate fibres run partly independently and partly with the uppermost fibres of the thyro-arytenoid into the inner and outer walls of the saccules of the ventricles. The latter are sometimes known as the aryteno-epiglottidean muscles. The modern view is to regard the arytenoid muscle as a continuation of the thyro-arytenoid and as exemplifying the existence of a glottic sphincter. The muscle draws the two arytenoid cartilages together, which approximation when complete is accompanied by depression, owing to the shape of the crico-arytenoid joints. It is supposed that in swallowing the two arytenoids are drawn together and at the same time forward, so that their upper ends come in contact with the posterior surface of the epiglottis.

CHAPTER XII.

EXAMINATION OF THE LARYNX.

THE patient should be seated as for examination of the pharynx. Light may be obtained from any good lamp, Argand gas-burner, or electric source. The fixture should be so constructed as to be easily raised, lowered, and turned from side to side (Fig. 236). A very useful apparatus is a Welsbach gas-burner on an Argand frame and moving up and down on the standard of a student-lamp. If the source of light be electricity, the bulb must have a glass covering of such construction that the shadow of the incandescent filament shall not interfere with

FIG. 236.



Mackenzie's gas-bracket.

the clearness of the image. The Phillips photophore (Fig. 237) meets all necessary requirements in this respect. The head-mirror is worn as for examining the pharynx. It may be fastened to a rod running from the condenser (Fig. 238) or worn on the usual head-band (Fig. 239). In the latter instance it should be placed over the eye corresponding to the side of the examiner on which the light is placed; the latter should be at the level of the top and a little behind the patient's ear. In addition there is needed a laryngoscopic mirror (Fig. 240) with

a diameter of one inch, the glass being at an angle of one hundred and twenty degrees with the handle. The patient having been suitably placed with back straight and the body very slightly inclined forward, he protrudes the tongue, which is grasped in a napkin or towel held by the examiner, the latter's left thumb being above and his forefinger

FIG. 237.



The Phillips photophore.

below the tip of the organ. Care must be taken not to pull on the tongue, and the forefinger must be held just above the level of the lower incisor teeth, so that as the tongue is gently held down it shall not come in sharp contact with the incisor edges. The examiner next warms the laryngeal mirror by holding it at a little distance from the flame (or spirit-lamp if electricity is used) until the thin film which immediately appears on the glass is dissipated. Before each insertion of the mirror it should be cleansed, warmed, and tested on the examiner's own skin.

The shaft of the mirror should be held by the examiner exactly as he would hold a pen-holder. The above manipulations having been completed, the mirror is passed with glass downward and the shaft held away towards the angle of the mouth until the point of junction of the shaft with the mirror reaches the base of the uvula. Then, by a movement upward and backward, the uvula will be made to lie on its posterior sur-

FIG. 238.

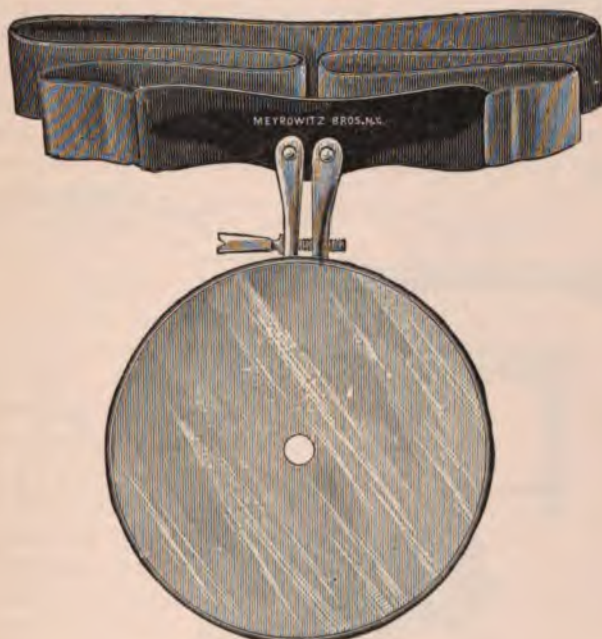


Shade and condenser.

face, which will also partially support the edges of the soft palate, and the distal rim of the mirror will be in contact with the posterior pharyngeal wall. The patient is directed to phonate a vowel of high pitch, which act depresses the base of the tongue, lifts the epiglottis, and brings into view the laryngeal cavity. While the parts are in this position the

patient may be directed to take a few deep and rapid breaths, as they exaggerate the normal excursions of the vocal cords and at once determine their condition as to motility.

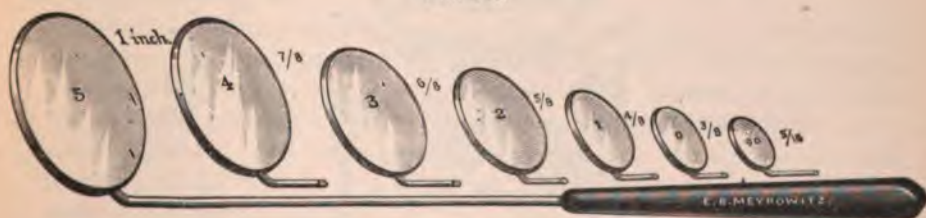
FIG. 239.



Pomeroy's head-mirror.

In some instances the patient will do better to hold the tongue himself in the manner described, thus leaving both hands of the examiner free. This is of course necessary in all instrumentation for therapeutic

FIG. 240.



Throat-mirrors.

purposes. Some writers suggest that if the patient is allowed to hold a small hand-mirror during examination he will see just what is wanted on his part, and will more readily co-operate with the examiner in securing the desired relaxation of the various structures. The fore-

going seems to be very easy of accomplishment, but practically it is extremely difficult, and at times at the first examination absolutely impos-

FIG. 241.

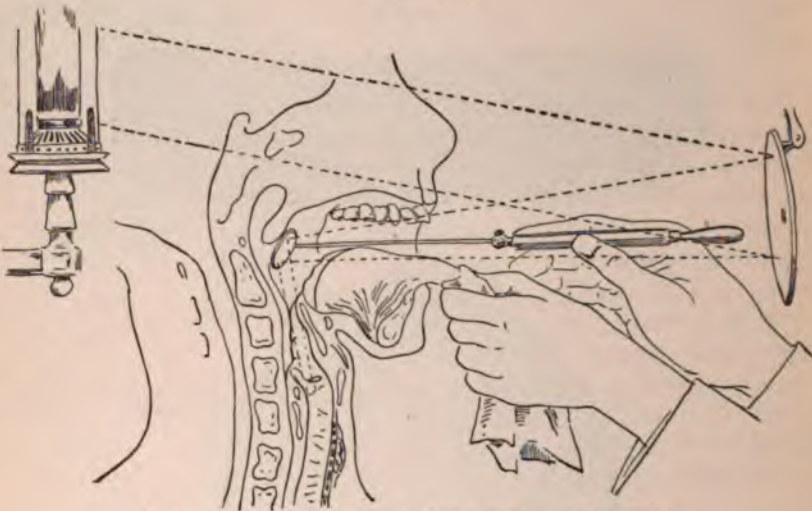
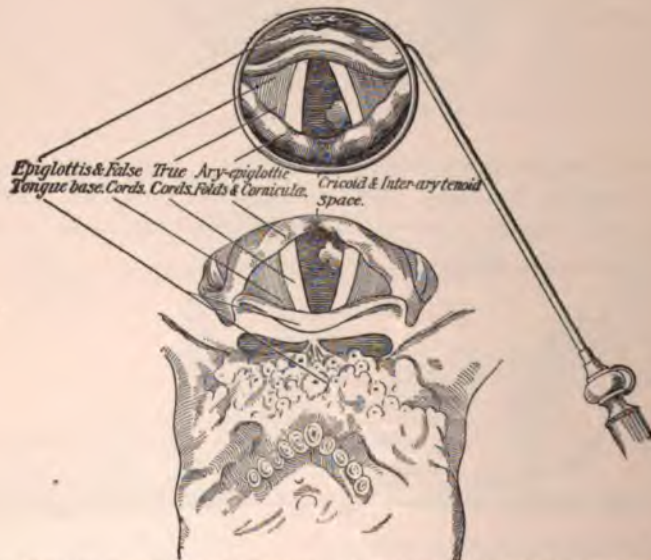


Diagram showing the principle of laryngoscopy. (Bosworth.)

FIG. 242.



Diagrammatic view of tongue-base, epiglottis, arytenoids and aryepiglottic folds, ventricular bands, and vocal cords, with the laryngoscopic reflection. A polyp shows below the left cord. (Schrötter.)

sible. This arises partly from fear on the part of the patient and partly from the natural irritability of the parts. The patient should be assured

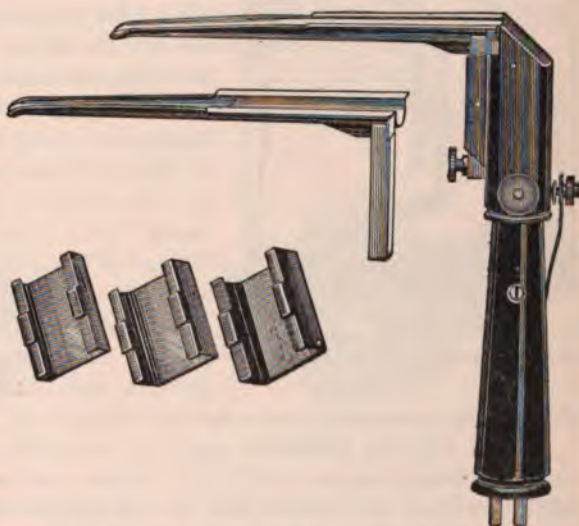
that this is only an examination and a procedure absolutely free from all pain. It is often well to partially insert and then withdraw the mirror several times before any real attempt is made to get a view of the parts, and the natural irritability may be overcome by having the patient suck ice-pellets for a few minutes. In cases of moderate irritability it may suffice to gently swab the fauces with a *weak* solution of cocaine or eucaine several times before the insertion of the mirror. If there is much acute inflammation of any of the throat structures a sedative inhalation may be used every few hours for a day or two. In the worst cases the patient should be directed to gargle the throat every two hours with a strong bromide solution (to be afterwards swallowed) for a few days, by which time it will generally be feasible to complete the examination.

In regard to children, the advice of Lennox Browne may here be quoted. "I take every step exactly as with an adult, only differing, perhaps, in saying less rather than more to the patient beforehand; for telling a child that he is *not* going to be hurt is often the first suggestion that he *may* be." He summarizes the difficulties of infantile laryngoscopy as, first, a refusal of the child to open the

mouth, to be overcome by a little patience or compression of the nostrils, when the patient must open the mouth to breathe; second, refusal to protrude the tongue, which indeed is not really necessary; and, third, the pendent position of the epiglottis, for which, if the first two have been overcome, the examiner may rely on the advantage of reflex gagging, which will permit of a fair, though momentary, view of the parts it is desired to inspect.

Kirstein, of Berlin, has recently introduced or rather revived the method of direct examination of the larynx and of the posterior wall. "Orthoscopy" instead of "autoscopy" has been suggested as a name for this method, since the former conveys the meaning that in this procedure the laryngotracheal axis is made to form more or less of a straight

FIG. 243.



Kirstein's laryngoscope with electric-light attachment and interchangeable depressor. (Thorner.)

line with the buccal cavity. The method is of limited application only, for but few patients are able to bear without resentment of the parts the prolonged and somewhat painful manipulation which the method necessitates. The relative positions of patient and examiner can be appreciated by reference to the figure.

FIG. 244.



Position of neck and head during examination with the electric orthoscope or autoscope. (Thorner.)

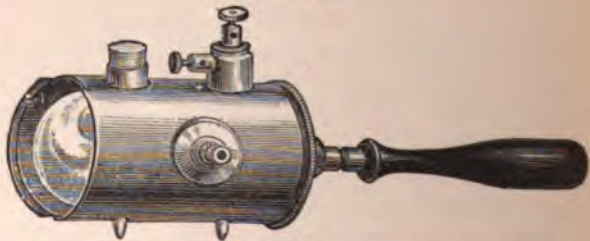
The instrument consists of, first, a spatula fourteen centimetres long, and notched so as to fit against the median glosso-epiglottic ligament. The general shape of the spatula accommodates itself to the parts which it is to fit; second, a hood which is attached to the front end of the spatula and serves to keep the passage clear (for this hood Thorner has substituted a flat plate, which makes the instrument less cumbersome and just as efficient); third, the handle of the spatula set at right angles and carrying cords for attachment to the electroscope. It will be seen that by this method the examiner looks directly down upon the cords themselves instead of upon a reversed image of them, as by the usual mirror method. The Kirstein method has not come into general use, as the apparatus is somewhat expensive and instruments for operative

work with it must all have a special shape.

The X-ray has also been used for examination of the larynx. It is useful to detect tumors and foreign bodies, but, as a rule, whatever information it gives can be obtained by less cumbersome methods. Freudenthal has applied the principle of translumination in examining the larynx by means of a device here figured. A yellowish-red light is thrown through the laryngeal tissues, making their appearance quite different from the ordinary.

Finally, mention may be made of the method of Killian for getting a view of the posterior wall of the larynx. The patient stands with head well bent forward, while the examiner kneels in front of him, holding the mirror up against the uvula. It must be borne in mind,

FIG. 245.



Freudenthal's electric lantern for translumination of the larynx.

however, by beginners that the change in the angle of the mirror changes the apparent customary relation of the parts from that of the ordinary laryngeal image. In the Killian method the epiglottis appears in front and the posterior laryngeal wall behind.

THE LARYNGEAL IMAGE.—Reference to previous figures will show that the laryngeal image is reversed in an antero-posterior direction, and that portion of the larynx which is really farthest from the examiner seems nearest to him in the picture. There is no reversal of lateral position. What is right or left in the mirror is right or left in the larynx. In addition, the examiner must remember that he is sitting opposite to the patient, so that his own right is the latter's left. To the practised observer all these points are familiar, and he unconsciously makes the necessary allowances, so that his description of what he sees is definite and accurate as to anatomical site, but the beginner may find some difficulty in taking into proper account all these peculiar relations.

The first object coming into view will be the epiglottis. Backward and downward from this run folds of mucosa, one on each side to the

FIG. 246.



Laryngeal image during breathing.
(Bresgen.)



Laryngeal image at the beginning of
phonation. (Bresgen.)

arytenoid cartilages, which appear as small knob-like bodies in the median line in the lower part of the image, which separate and approach very slightly in ordinary breathing, coming snugly together on phonation. These folds form the lateral boundary of the top of the larynx. On each side is the pyriform sinus, a locality which should always be carefully inspected when looking for foreign bodies. In each fold, nearer the posterior than the anterior portion, will be seen the rounded prominences of the cartilages of Wrisberg. The cornicula surmounting the arytenoids are practically indistinguishable from them.

Below the aryepiglottic folds are seen the ventricular bands or false cords, which extend from the receding thyroid angle to the arytenoid cartilages; they are reinforced by the thyro-arytenoid ligaments and are parallel to the true cords. Just below them are the ventricles of the larynx, and forming the inferior border of these, the true vocal cords. Perhaps the word pearl-gray describes their color as well as any. Between the cords is the rima, or chink of the glottis, constantly changing its shape

in breathing and phonation. The vocal process sends a minute cartilaginous prolongation into the cord, which is seen just in front of the latter's attachment to the arytenoid. Under some circumstances it is possible to hold the mirror so as to get a glimpse during deep inspiration down the trachea, even to its bifurcation.

An estimation of the exact normal color of the laryngeal mucosa and contour of its various parts can be acquired only by practice. Here, as elsewhere, there are variations in appearance perfectly compatible with health and proper function. This is especially the case with the vocal cords, which vary greatly in color.

PHYSIOLOGY OF THE LARYNX.

The function of the larynx is twofold. It presents movements synchronous with those of breathing, and is also concerned in voice production. With every act of inspiration there is a slight outward rotation of the arytenoids on the cricoids by means of the contraction of the posterior crico-arytenoid muscles, and in addition there is an outward rocking of the arytenoid on the cricoid so as to open the glottis as widely as possible. In expiration the muscle simply relaxes and the air passes out through the glottis in a passive way. The contraction of the above-named muscles is a reflex act originated by the direct stimulus of the blood, with diminished oxygen, on the respiratory centre in the floor of the fourth ventricle. In quiet respiration these movements of the larynx are barely perceptible, but a slightly increased depth of breathing will at once bring them into play.

Furthermore, the epiglottis has a certain function in the act of deglutition. Much stress was formerly laid on its office as a "lid" to the laryngeal box to prevent the entrance of food into the latter, but it can be removed in animals without impairment of the act of swallowing, and in man is frequently wanting as the result of various destructive processes, yet after the patient has learned to accommodate himself to the altered condition he can swallow without danger or even difficulty. Stuart and McCormack¹ have shown that in the act of swallowing the epiglottis projects upward in close contact with the base of the tongue. The cartilage has also been regarded as a "sounding-board" reflecting the vocal wave to the pharynx, where it is in part articulated. If the edges of the cartilage are irregular and ragged the voice is apt to become rough and harsh, and if the cartilage is entirely destroyed the voice is much less distinct.

The act of phonation is essentially a vibration of the column of air in the upper passages, induced by the partial arrest of the respiratory current driven through the narrow slit formed by the approximation of the vocal cords and moulded by the structures higher up into articulate

¹ Jour. Anat. and Physiol., 1891-92, vol. xxvi. p. 231.

speech. The muscles which approximate the cords are the lateral crico-arytenoids and the interarytenoid. Their combined action is very simple; the tension of the cords is a matter somewhat more complicated. Concerning tension, Bosworth notes that it is not so much a matter of stretching the vocal cords to their greatest possible length as it is of holding their edges in a state of firmness and rigidity, whether the opening between the edges be a straight line or oval. The cricothyroid muscle draws the cricoid cartilage upward and backward, thus lengthening and rendering tense the cords. Finer tension is regulated by the thyro-arytenoid. The apparent action of this muscle would seem to be to relax the cords by the approximation of their two attachments, but the cords themselves are in a sense the aponeurosis of this muscle on each side, so that the action of the latter through the whole extent of the cords seems to increase tension and to give it a finer adjustment. Moreover, it is supposed to act as a damper, checking the over-vibration of the sonorous media.

There are, then, two sets of muscles, one of which controls the width of the glottic opening, the glottic openers or abductors and the glottic closers or adductors; and, second, the group which effects the tension of the vocal cords; both sets act together in vocal production: the varying positions of the cords are the resultants of this combined action; hence the difficulty of too definitely assigning to any one muscle a unique action outside of which it never varies.

An interesting study of the function of the ventricular bands in phonation has been made by Dogodany,¹ who found that in sixty-two per cent. of one hundred and fifty cases examined the ventricular bands presented movements during phonation. It is possible, under various pathological conditions, for these false cords to assume the functions of the true cords and to act as supplementary constrictors of the glottis.

Reference may briefly be made here to one of the triumphs of modern surgery and after-care in the successful removal of malignant tumors of the larynx and the complete extirpation of that organ, with the subsequent development, owing to the wonderful adaptive powers of nature, of a voice which has answered all the necessities of life. Such a case was exhibited some years ago by Cohen, in which all communication was shut off between the trachea and the mouth. The patient seemed to swallow the air, which distended the lower pharyngeal cavity, whence it was expelled in phonation by the pharyngeal muscles. While articulation was produced by the lips and tongue, there was some doubt as to what the vibrating medium really was. It was variously considered by those who examined the case to be the soft palate, edges of the pharyngeal constrictors, etc.

¹ *Monatsschr. f. Ohrenh.*, 1899, Bd. xxxiii. S. 10.

CHAPTER XIII.

ACUTE INFLAMMATIONS OF THE LARYNX.

THESE may be of the simple exudative variety, coming on alone or as a complication of many systemic states and general fevers. In addition, there are the acute conditions due to specific causes, such as syphilis and tubercle, and those attended by membranous formation, such as diphtheria, true and false.

ACUTE CATARRHAL LARYNGITIS.—This is an exudative inflammation of the mucous lining of the larynx, the peculiarities of which in this situation are due to anatomical conditions.

Etiology.—Modern views incline to the belief that acute catarrhal laryngitis is in the majority of cases the result of the lighting up into an acute stage of a chronic catarrhal process either in the larynx itself

or in the adjacent tissues. All those whose occupations subject them to much dust have their upper air-passages in a state of constant irritation and hyperæmia, which, under the exciting influence of fatigue, exposure to cold and damp, etc., readily takes on an acute condition. Inhalation of tobacco-smoke in a confined space, of irritating odors and fumes of all sorts, abuse of alcohol, and excessive vocal effort are all liable to be followed by acute inflammation. Several drugs are capable of setting up the disease, especially potassium iodide, and Béthi¹ has reported a case due to arsenic.

FIG. 247.



Acute laryngitis. (Krieg.)

It occurs at all ages, and is more common in men, doubtless from the fact that they are more exposed to irritants. In children a cold in the head is apt to travel downward, while in older people the brunt of the attack seems to fall first of all on the larynx, while the parts above become secondarily affected.

Pathology.—In a case of ordinary severity the submucous tissue is not affected. There is the usual sequence of vascular contraction, quickly followed by dilatation and arrest of secretion. The dry stage is apt to last longer here than in other mucous membranes; it is succeeded by the exudation of serum in small quantity and increased production of mucus. Naturally, the process appears most marked at those sites in which the

¹ Wien. Med. Presse, 1897, S. 326.

mucosa is loosely related to the subjacent parts, as on the ventricular band, interarytenoid commissure, and aryepiglottic folds (Fig. 247). Between the arytenoids the mucosa frequently presents rugæ which suggest the unevenness of an ulcerative process (Fig. 248). The true cords show only vascular dilatation, and the lesion does not, as a rule, extend below the glottis. The increased secretion contains desquamated epithelial cells and emigrated leucocytes. The lesions may be confined to very definite areas in the larynx, while surrounding portions show no change.

Symptoms.—Ordinarily the constitutional symptoms, if indeed present, are of the mildest possible degree, consisting of a slight fever with moderate general malaise. Local pain is not usually felt, though the general region of the larynx may be sensitive on manipulation. The occurrence of cough signifies an involvement of those areas which Stoerk called twenty years ago "cough spots." These are the posterior surface of the larynx, the interarytenoid fold, the bifurcation of the trachea, and the under surface of the vocal cords. As Bosworth points out, under these circumstances a cough of any severity probably means the existence of a mild tracheitis and not a laryngitis pure and simple. Glairy mucus may be expectorated, but swallowing is generally not much interfered with.

The most obvious symptom and the one giving the patient the greatest concern is the partial or entire loss of voice. Partial loss is attended by alterations in quality, so that the patient speaks with more or less hoarseness. Even when audible phonation is possible it requires some effort, and patients are apt to voluntarily confine themselves to a whisper. The quantity of exudation posteriorly is rarely sufficient to prevent approximation of the cords.

Moreover, it is evident that the action of the delicate muscles of phonation, some of which are practically embedded in the mucosa, must be greatly interfered with, a fact which would amply account for vocal impairment. In this simple form of the disease in the adult dyspnoea is wanting.

E. J. Moure¹ has described a form of laryngitis seen in association with recent influenza outbreaks. The brunt of the attack is borne by the arytenoid region, which becomes intensely red and tumefied. Dysphagia is marked and persistent, and the cases are distinctly worse at night. They last from five to eight days and are without sequelæ.

Diagnosis.—Examination of the larynx sometimes shows but little evidence of inflammation, but a general congestion of varying intensity with a redness of the cords may be expected. Caution must be ob-

FIG. 248.



Rugæ of interarytenoid space simulating ulceration in simple laryngeal catarrh. (J. D. Arnold.)

¹ Revue hebdomadaire de Laryngologie, 1900, No. 29, p. 77.

served, however, in diagnosing the condition from the latter alone, for in male vocalists the cords are often of a reddish-pink color, even under normal conditions. In women, however, redness is to be considered (unless the patient habitually drinks wine freely) abnormal congestion. The latter is naturally most marked where the attachment of the mucosa to the underlying parts is loose. In mild cases the small vessels of

FIG. 249.



Hemorrhagic laryngitis. (Krieg.)

the cord stand out in contrast with the whitish appearance of the cord itself. From this condition the disease may progress through all grades of severity, some cases being attended by hemorrhagic symptoms and the expectoration of blood after a violent attack of coughing. Under these circumstances there is generally found a circumscribed patch where a superficial vessel has ruptured. This is the hemorrhagic laryngitis of some writers (Fig. 249).

The increase in size and number of vessels, the lessened resistance of their walls, and the periodical increase of blood-pressure from clearing the throat predispose to this accident. If the process should become severe enough to involve the subglottic area, a rounded projecting mass underneath each cord, encroaching more or less on the lumen of the air-tube, may be expected (Fig. 250).

In the mildest type of cases the excursion of the cords is scarcely at all interfered with, but in more severe types the interarytenoid swelling prevents perfect adduction, while abduction is not at all disturbed. It may happen that, owing to purely catarrhal causes, there is a partial paresis in one or more muscles, and there occur the peculiar appearances incident to these respective conditions. Perhaps the most common is an elliptical shape of the rima due to impaired action of the thyro-arytenoid muscles; also there may be a triangular space between the posterior extremities of the cords due to imperfect function of the interarytenoid muscle. Bosworth inclines to the view that these are rather unnecessary refinements, and that the mechanical conditions present from swelling amply account for the clinical picture shown.

Course and Duration.—The disease runs its course in from seven to ten days, usually subsiding without special incident or sequel. It is never fatal, and is of importance only to those whose occupation renders vocal integrity necessary.

Treatment.—While general medication is not, as a rule, called for, it is well to act on the bowels freely, and to give a full initial dose of

FIG. 250.



Subglottic edema. (J. S. Cohen.)

quinine or Dover's powder, which often has the happy effect of breaking up the attack. Aconite may be given up to its physiological effect, or small doses of bromide in combination with a little paregoric. Serviceable measures are a hot bath, followed by quick drying and getting immediately into bed, a mustard foot-bath, etc. The exquisite sensitiveness of the interior of the larynx renders only the mildest measures applicable during the acute stage. Inhalation of sedative vapors is often grateful, and for this purpose there may be used a mixture of menthol (half a drachm), eucalyptol (six drachms), and compound tincture of benzoin (three ounces), one teaspoonful being placed in a pitcher or other vessel containing a pint of boiling water, and covered about its top with a folded towel, which serves the purpose of a funnel. Inhalation may be continued as long as steam is given off, but care should be taken that the patient does not go out into the open air for some twenty minutes afterwards. Compound tincture of guaiac is by some preferred to the benzoin. These measures do not shorten the attack, but they alleviate the sufferings of the patient during its severity. If the case is seen before actual exudation has occurred, the use of a weak spray of suprarenal extract may by depletion of the vessels abort the attack.

After the acute symptoms subside topical applications may be made. In fresh cases they should be effected by spraying a very weak solution, say of silver nitrate not over three grains to the ounce, or of zinc acetate not over ten. If the case becomes sluggish and there seems to be partial paresis of the cords, iron salts may be used, one part of the muriated tincture and two of glycerin being applied in spray or by means of a soft cotton brush. The latter method of application has been objected to as likely to injure the delicate tissues of the larynx, but this need not result if one is careful. A most useful instrument for this purpose is the Heryng laryngeal applicator, which consists of a curved shank terminating in an oval loop, down which travels a screw collar. The loop may be threaded with a wisp of cotton, held in by the collar, and by unscrewing the latter after use the cotton can be instantly withdrawn. No objection can, therefore, be made on the score of lack of cleanliness, as is the case with the ordinary sponge or brush. The wisp of cotton may be left long, so that after it reaches the level of the cords and spasm is excited the medicine is squeezed out of the cotton and bathes the tissues without the least injury from the instrument. The use of various kinds of throat lozenges is at best unreliable, unless they contain such agents as muriate of ammonia or cubebs, which are volatile at the temperature of the body.

If examination of other parts of the upper air-tract shows that the laryngitis has been superinduced by the condition of the former, treatment suited to each case should at once be instituted, in order to prevent a repetition of the attack. The nose and nasopharynx should be care-

fully cleansed and mild astringents applied, glycerite of tannic acid being useful for this purpose.

In regard to the restoration of vocal power in the quickest time possible, there is no plan that will yield invariable success. Much can, however, be done by keeping the patient *absolutely* quiet, with entire rest to the larynx, speech being forbidden, and cold may be applied to the larynx, preferably by means of the coil. The room should be at the temperature recommended for the sick (70° F.), and the air charged with moisture. A weak solution of silver nitrate may be applied to the larynx, and repeated, if necessary, once, or at the most twice, during the day. A saline should be given to keep the bowels open, and the exhibition of aconite up to the physiological effect, and preferably in the form of aconitine in small and repeated doses, sometimes has marvellous effects. Patients should be warned of the risk they run in trying to work while the vocal organs are still in such a sensitive condition. A moderate use of coca wine will sometimes help to tide over a crisis.

A. Abrams¹ has suggested a novel plan for the relief of the aphonia and dysphonia of acute laryngitis. "First, one should mark approximately with a pencil on each side of the neck the point in the thyro-hyoid membrane where the internal laryngeal branch of the superior laryngeal, the nerve of sensation to the larynx, passes into the latter organ. Over the points marked with the pencil, methyl chloride or a spray of rhigolene is to be used to freeze the parts. The relief in most instances is almost instantaneous, and phonation, which was before difficult or painful, can be performed with perfect ease. In some instances the relief is of short duration only, in which cases freezing must be applied again or several times. This same method may be employed with advantage in neuroses of the larynx like laryngismus, spastic aphonia, and in the pharyngeal crises of tabes dorsalis."

ACUTE CATARRHAL LARYNGITIS IN CHILDREN.—The larynx of the child differs from that of the adult not only in size but in anatomical structure, in that the mucosa is more vascular and more loosely attached to the parts beneath. Moreover, there is often a more definite limitation of the disease, which appears above the cords in mild and below in severe symptoms.

Mild Form.—This form is practically the same as seen in adults. It occurs at any age up to twelve years, more commonly under four or five. It may form part of an acute catarrh, involving the entire upper air-tract, or be limited to the larynx. The disease in the child is more apt to be marked by a slight febrile movement and general malaise. Local symptoms are mild, the voice being moderately hoarse but rarely lost, and there is generally considerable tenderness of the parts on manipulation. The local changes are confined to the same areas as in the adult.

¹ Therapeutic Gazette, November 15, 1898, p. 726.

An attempt should always be made to examine the larynx, though in a very young child the examiner may be able to get only a momentary or no glimpse at all. The condition is not fraught with danger, and will generally subside in a week or a little over. A possibility is the extension of the inflammation to the parts below the cords, when the status of affairs becomes quite different. The necessity of an accurate diagnosis is the main feature, as any malady that interferes with the integrity of the larynx should always be most carefully diagnosticated. If symptoms become progressively worse with reference to the passage of air, it is evident that there may be present a more severe disease to deal with than a mere catarrhal change.

The bowels should be moved by castor oil, and some application made to the chest and well rubbed up into the neck. For this purpose Stokes's turpentine liniment, diluted with a little bland oil, so as not to be too strong for a child's skin, may be used. It is often impracticable to give a child inhalations, although it may be kept in a medicated atmosphere in a small room, while internally some preparation of ammonia, with a little paregoric, should be given in small doses. If the attack has seemed to come from an acute rhinitis, application to the nasal mucosa of a very weak cocaine solution, or of suprarenal extract followed by nasal irrigation, will often effect a cure.

Severe Form.—In the severe form the brunt of the inflammation is borne by the subglottic tissues, and there is a consequent obstruction to the air-conduit giving rise to symptoms of great gravity. This form of disease is variously known as false, crouping, or spasmodic croup, laryngismus stridulus, etc. It is well to avoid the use of the word croup and its derivatives, except as referring to a definite variety of pathological change the most obvious expression of which is the formation of a false membrane.

The causes of the severe subglottic type are in general the same as those of the milder forms. It may occur in all classes of children, though most attacks are found in those who are disposed from any cause to lymphatic overgrowth, the "lymphatism" of the French school of pathologists, as these children constantly suffer from upper air-tract catarrhs, but attacks may frequently be referred to some dietetic error.

The pathological change is not unlike that of the mild form, but there is undoubtedly an engorgement of the lymphatic vessels, which at this site in the larynx are especially numerous, and which press forward the structures overlying them into the lumen of the air-tube.

The symptoms are of the same general variety as in the mild form, but much more severe, and fever may precede, follow, or be simultaneous with the local manifestations. There is dyspnoea, which is continuous, but presents exacerbations, stridulous cough and voice, and perhaps complete aphonia. The character of the cough is compared by Bosworth to that seen in aneurism or other thoracic tumors pressing on the trachea.

It is at the outset dry and harsh from arrest of secretion, it occurs in paroxysms, and the inspiratory stage has a peculiar crowing character. Boys are more often affected than girls.

A noteworthy feature of the disease is the nocturnal exacerbation. The child may be only slightly sick on retiring, but after a few hours' sleep it suddenly awakes with a severe paroxysmal cough and dyspnoea. This forms the "*laryngismus stridulus*" of some writers. The typical attack presents these exacerbations on three or four successive nights, the second generally being the worst. They usually subside as soon as the membrane is moistened by the various therapeutic measures adopted, or the patient dislodges from the larynx the accumulated mucus.

In establishing a diagnosis an attempt should always be made to get a view of the larynx, but practically this is possible in only a very few of the cases. The question simply resolves itself into whether or not the child has diphtheria. As shown by Syme, most of the membranous croup of former writers is really diphtheritic in character. Diphtheria does not always present a membrane in the pharynx at the time of the laryngeal deposit, but this matter is treated more in detail in the chapter on that disease. An opinion must be formed here from the general objective symptoms, the night attacks, the improved condition in the daytime, the higher fever, and the more active type of constitutional disturbance suggesting catarrhal disease, while the marked prostration, the progressive character of the symptoms, and the evidences of systemic blood-poisoning indicate diphtheria.

Acute catarrhal laryngitis generally runs its course in a week or so, and recovery is the usual result, the fatal cases being referable to a complicating capillary bronchitis or lobular pneumonia.

As to the treatment, the chronic condition of lymphatism in which many of these children are demands iodine in some form. The syrup of the iodide of iron or of hydriodic acid may be given in proper dose. The former is well combined with cod-liver oil, and must be continued for some months in order to secure a permanent result. Proper directions as to clothing, bathing, and food must be given, and, if necessary, enlarged glands and tonsils must be removed by surgical measures.

For the acute attacks the child should be kept in a warm atmosphere saturated with moisture, and calomel or gray powder in two- or three-grain doses should be immediately ordered. Preparations of ammonia with Tolu syrup should be given in order to re-establish secretion. Opiates are to be avoided, but if a sedative mixture seems necessary to obtain quiet, preference should be given to codeine or the newer remedy, heroin, in very small dose.

In the acute nocturnal exacerbations the principal aim should be to clear out the larynx, and for this it has been customary to use various emetics, with a view to relaxing the supposed laryngeal spasm; but, as has been said, there is no positive proof that this exists; hence an

equally good effect can be obtained from derivative measures, such as a hot mustard-bath. Warm inhalations may be tried, and if vomiting is desired, it can be obtained more promptly by the finger than by depressant remedies. Hot fomentations are also indicated. In cases in which all these measures fail to relieve dyspnoea, inhalation of amyl may be tried, or some form of instrumentation. In some cases the passage of a flexible male or a hard female catheter will afford relief. The intubation-tube and tracheotomy are at the surgeon's disposal, but such radical measures as these are rarely called for.

CROUPOUS LARYNGITIS.—This is the condition known as membranous laryngitis, or true croup, and is characterized by the appearance in the larynx of a false membrane due to bacilli other than those of diphtheria. The duality or not of the two affections has been and still is a matter of much discussion among bacteriologists and clinicians. Many cases formerly regarded as membranous laryngitis would now undoubtedly be considered diphtheria; but there seems to be a group of cases not purely diphtheritic, nor, in fact, from a bacteriological stand-point, diphtheritic at all, to which the name croupous laryngitis may properly be given.

Etiology.—The malady is without doubt a germ disease, but it remains to be seen whether one particular micro-organism is the exciting cause or whether this property may not be shared by several of a group of bacilli. Whatever germ may be the cause, it undoubtedly commences its action high up in the fauces and gradually works downward. Few cases occur after the ninth year, the earlier years of childhood being the most susceptible, and some children show this proclivity more than others. As in the nose, so in the larynx there occurs an inflammation attended by the formation of a false membrane without the existence of a true diphtheria. It is evident that the use of the word diphtheria as signifying simply a membranous exudate is no longer permissible, as the latter requires a qualifying term referring to the bacteriological cause.

There may be, it is true, membranous laryngitis from other causes than idiopathic germ invasion. Thus, Price Brown records the case of a woman twenty-five years of age whose tonsils he had cauterized with the galvano-cautery. Three days later a membrane appeared in the larynx, not continuous with that on the tonsil, but restricted to the ventricular bands and extending down to the true cords. Mild fever, complete aphonia, and moderate laryngeal stenosis were present. Steam inhalations and iron and glycerin internally led to a cure in five days, and no recurrence took place. Brown regarded the case as one of pure fibrinous deposit of staphylococcic origin. Other traumatic causes may be irritant inhalations, burns, scalds, etc., and various chemical agents used possibly in too strong solution. Traumatism may lead to a fibrinous deposit in the larynx, the former being of staphylococcic origin. Finally,

it remains to be said that this form of intralaryngeal inflammation may complicate the exanthemata, especially measles and scarlet fever.

Pathology.—The lesion consists of the formation of a false membrane, which may appear on any part of the surface of the larynx, either in continuous areas or in patches. The membrane is formed of fibrin, entangling in its meshes leucocytes, blood-cells, and desquamated epithelium, and removal leaves a bleeding surface. It is essentially an exudative inflammation, with degeneration or death of tissue. The necrosis may involve only the epithelium, which passes into the condition of coagulation necrosis and forms part of the false membrane, or it may involve also the stroma. The death of the epithelium alone leads to simple erosions, that of the stroma to ulcers of varying size and depth.

Symptoms.—There is a chill, followed by a febrile movement of rather high range and sthenic type, a full and bounding pulse, anorexia, constipation, diminished and high-colored urine, and considerable bodily pain. Swallowing is painful, the distress radiating to the ears. The throat symptoms begin to make their appearance as hoarseness and dyspnoea, with a stridulous cough. Difficulty in breathing is noted both in inspiration and expiration, as the air-conduit is narrowed. If the disease has begun higher up, and later extends to the larynx, this extension is generally marked by a sudden rise in the fever. Later the evidences of imperfect aëration of the blood appear, together with the signs peculiar to laryngeal stenosis,—viz., recession of the intercostal spaces, dilatation of the nasal alæ, etc. Unless the condition is relieved, the patient gradually dies from carbonæmia.

Course and Prognosis.—The disease generally runs its course in from four to six days, by which time death ensues or resolution has begun. The prognosis is always grave, especially in children under three years of age. There is great danger of extension of the malady to the trachea and bronchi, a complication always fatal in spite of every therapeutic resource.

Treatment.—The patient should be kept in a warm room and made to inhale the vapor from slaking lime. This should be done about every four hours, and in the intervals he should breathe the vapor of hot water constantly generated by a spirit-lamp in a kind of tent. A simple contrivance is to tie a large open umbrella to one corner of the bed and drape a sheet over it. Medicinal treatment should be begun with calomel, two grains of this or of the gray powder being given every two hours for the first day until the characteristic green stools appear. This is exhibited with the idea of limiting the plastic formation in the larynx. If there seems to be much loose membrane in the larynx an emetic may be administered to dislodge it; for this purpose the depressing emetics with a constitutional effect should be avoided. A little salt in warm water will probably answer every purpose. If the fever is high, cold sponging may be used, and if the pulse is weak, alcohol should be

administered. Undoubtedly the remedy most frequently used is the time-honored muriated tincture of iron; of this a child of three years can take ten drops, well diluted with glycerin in water, every two or three hours. If all the foregoing fail to relieve the patient, resort must be had to either intubation or tracheotomy, the problem being to keep up a sufficient supply of oxygen until the membranous formation in the larynx shall have ceased.

PHLEGMONOUS AND OEDEMATOUS LARYNGITIS.

It is hard to reconcile the classifications of certain laryngeal affections made by different authors, for, while some regard certain clinical manifestations as merely symptomatic, others, under the same circumstances, use the name of the most prominent symptom as the designation for a distinct affection. This is notably the case with the phlegmonous and œdematous conditions now to be considered. It is preferable to follow the views of those who make two general designations,—(1) phlegmonous laryngitis and (2) œdema of the larynx.

ACUTE PHLEGMONOUS LARYNGITIS.—By this term is meant an acute laryngeal inflammation of the mucosa occurring either without apparent cause or as a complication of acute involvement of surrounding parts. The peculiar features of the disease are its rapid onset, unusually active character, and the depth to which it extends.

Etiology.—A predisposing cause is the presence of sepsis in some form. It has been looked upon as essentially a laryngeal erysipelas, though primary cases are rare. Those instances referable to cold are doubtless more directly due to increased septic activity occasioned by the lowered vitality incident to the chilling. More commonly the affection is secondary to the various forms of tonsillitis, pericervical suppuration, and the constitutional conditions incident to typhus, typhoid, small-pox, and diphtheria. Some cases are referable to trauma from a foreign body, to inhalation of scalding vapors, to the ingestion of an irritant poison, and to influenza, as reported by G. A. Richards,¹ who notes that Mackenzie mentions thirteen cases, to which number his own statistics add twenty-six others collected from various sources. Many of them have been reported as idiopathic abscess of the larynx.

Pathology.—The first stage is one of engorgement of the vessels, quickly followed by a serous transudation. This is especially noticeable in those places where the mucosa is loosely attached to subjacent parts, such as the aryepiglottic folds, the ventricular bands, and the posterior aspect of the epiglottis. The mucosa covering these areas bulges, becomes very tense, and has a peculiar shining appearance. As a rule, the œdema does not extend to parts below. The exudation is generally symmetrical in appearance, and as the disease runs its course changes in character,

¹ Am. Jour. Med. Sci., May, 1890, p. 450.

becoming purulent. Abscess formation is more commonly unilateral, and occasionally the entire course of the disease seems confined to one side of the larynx.

Symptoms.—These consist of a chill, followed by fever and the usual evidences of malaise. The difficulty in breathing and phonation from direct mechanical interference draws immediate attention to the seat of the disease, the stridulous voice sometimes being the first local evidence.

Diagnosis.—This is to be made by the use of the laryngeal mirror, supplemented, if need be, by digital examination. The enlarged ventricular bands and the posterior surface of the epiglottis will appear tense and projecting, with below and between them a triangular opening, which is the glottis. Palpation may determine the nature of the swelling and the presence or not of a foreign body. The history of the case will also afford valuable information.

Course and Prognosis.—The disease generally lasts four or five days, and must receive the closest possible attention for thirty-six hours. If the dyspnoea has not reached the danger-point in this space of time, the inflammatory process will generally undergo resolution; but even if it goes on to suppuration, surgical intervention, so far as opening the air-passages, will not often be required.

Treatment.—A brisk cathartic should be given at the outset. The ice-bag or the ice-water coil or leeches may be applied over the larynx externally, but main reliance must be placed upon early scarification of the inflamed area. If the dyspnoea be not too great and the patient have a fairly tolerant throat, this may be performed with a guarded bistoury, under the guidance of the index-finger; under other conditions the laryngeal mirror should be used. The scarification should be repeated two or three times daily until permanent subsidence of the swelling has taken place. The possible necessity of a tracheotomy must always be borne in mind. In one case, in which sudden suffocation rendered it impossible to do this in time, Macewen¹ passed an ordinary urethral catheter into the larynx.²

ŒDEMA OF THE LARYNX.—This term has reference to a condition due to various affections. The œdema is practically the only lesion, there being no concomitant inflammation.

Etiology.—One class of cases is due to trauma, such as that from poisons, caustics, inhalation of irritants, scalding by hot water or steam, unskilful instrumentation, etc.; another class is due to the effect of potassium iodide in too large internal doses; a third class of cases is made up of those secondary to chronic visceral lesions, especially of the heart,

¹ Glasgow Med. and Surg. Jour., 1879, vol. xi. p. 252.

² The combination of mechanical conditions generally renders the insertion of an intubation-tube impossible. Pus should be evacuated as soon as its presence can be determined.

kidneys, and lungs; a fourth class is associated with such acute general maladies as pyæmia and erysipelas; while a final and large class complicates such local disorders as syphilis and tuberculosis of the larynx, cartilage disease, and retropharyngeal abscess.

Cases occurring without any apparent underlying cause are not uncommon. Generally, however, careful inquiry will elicit the fact of a depressed physical condition due to hard work or overstrain from some source, or exposure, to which the attack is directly referred. The latter may first expend itself upon the tonsils and uvula. Still another form is that due to the supposed angioneurotic œdema.

Pathology.—This is suggested by the definition of the disease; it is an œdema pure and simple. In a typical case the swelling presents itself as a three-sac exudation, composed of the aryepiglottic fold on each side and of the mucosa of the epiglottis in the middle. The ventricular bands and arytenoid commissure may also be invaded, while in some instances the œdema mounts over the top of the epiglottis and appears on its anterior surface. Cases have been recorded in which the ventricular bands alone were involved, and occasionally the œdema may be unilateral. In cases complicating the exanthemata and general diseases the cervical tissues outside the larynx may also be invaded.

Symptoms.—These are of sudden onset. The respiration suddenly becomes impaired, especially in inspiration, while expiration is not greatly interfered with. Inspiration becomes stridulous in character, while the voice is deep, and later lost; cough is often present, and is short and without expectoration. Pain is generally absent, but may supervene if the cervical tissues become infiltrated. The laryngeal mirror will at once reveal the site and nature of the condition with which the surgeon has to deal. The exact picture differs according to the localization and limitation of the effusion.

Prognosis.—The condition is always a grave one, and at the first appearance of dyspnœa the medical attendant must be prepared for prompt intervention.

Treatment.—The cause of the condition should be ascertained, and treatment commenced in accordance with the findings. If heart disease is present, cardiac stimulants should be given hypodermically. Combinations of digitalis with strophanthus and small doses of nitroglycerin should at once be injected. In liver and kidney diseases the bowels should be acted on promptly and the activity of the skin excited. The air of the room must be kept warm and saturated with moisture, the ice-coil may be used, as recommended for phlegmonous laryngitis, but the

FIG. 251.



Early stages of œdema. (Krieg.)

main reliance must be upon prompt and thorough scarification, as previously described under the heading of phlegmonous laryngitis; in fact, the local treatment of the two is practically the same.

DEFORMITIES, INJURIES, AND FRACTURES OF THE LARYNX.

DEFORMITIES.—In addition to the various deformities which result from different pathological processes, deformities may be due to defective development. Some of these which appear to be developmental may possibly be due to congenital diathesis, especially the syphilitic, though this cannot always be determined. Seifert and Hoffa¹ found a congenital web in the larynx of a girl of sixteen, which was so hard that neither a knife nor an electric point would penetrate it. It was necessary to enter the larynx from without (with previous tracheotomy) in order to effect division. The web was membranous posteriorly, but anteriorly it formed a thick curtain of tissue which passed forward obliquely, and was adherent to the anterior wall of the larynx about a finger's-breadth below the vocal bands.

Various other cases of membranous webs have been reported during the last few years. The symptoms of such a condition are the obvious ones of impaired air-supply, though in the quiet state no difficulty need be experienced. Treatment should consist in section of the web followed by systematic dilatation.

INJURIES.—So far as wounds not producing fractures are concerned, the general principles of modern surgical treatment apply, and no details need be given here. The resources of the surgical art of the present day enable one successfully to intervene in many cases formerly considered hopeless. The general plan to be followed is to approximate and retain in position all severed parts and to closely watch the breathing, being ready to intubate or tracheotomize as soon as serious respiratory embarrassment is noticed.

Concerning contusions, it need only be said that they present the same features as fractures, but to a less degree.

FRACTURES.—These usually result from blows, falls, or sudden compression, and may involve one or all of the laryngeal cartilages. It is not an uncommon result of warfare. Owing to the ossification of these structures in later life, the accident is more commonly seen during that period. In sixty-two cases quoted by Bosworth from Durham's statistics, the thyroid was involved alone in twenty-four, the cricoid alone in eleven, and both cartilages in nine. The remaining cases were made up of various combinations of fracture of these and other cartilages.

Symptoms.—The external appearance of the larynx varies according to the direction from which the trauma has come. If the force has been one exerting lateral compression, the anterior prominence of the organ is rendered even more noticeable. If the blow has come from the front, the

¹ Berlin. Klin. Woch., March 5, 1888, S. 192.

reverse is the case. More or less tumefaction of the soft parts is observed, and sometimes a subcutaneous emphysema. The trauma will rupture some of the blood-vessels, so that the patient begins to raise frothy blood-tinged mucus and has dyspnoea. The voice is impaired and cough is present with painful swallowing.

Diagnosis.—This is made by the presence of the foregoing symptoms, while palpation generally reveals crepitus. Emphysema will give a peculiar crackling feel. Corresponding to the displacement of the cartilages, there will be a distortion of the laryngeal image.

Prognosis.—This depends on the amount, and especially the site, of the injury. It is evident that an injury comminuting the cricoid cartilage is attended by greater danger than one that simply cracks the thyroid. Quoting again from Durham's figures, it was found that out of the sixty-two cases there were twelve recoveries, in six of which the thyroid alone was affected, in two the thyroid and hyoid bone were involved, while in the remainder the exact seat of injury is not mentioned. Possible complications are suppuration and pneumonia.

Treatment.—The patient should at once be put to bed with the shoulders slightly elevated, ice-bags or, better, the Leiter ice-coil should be applied, and, if there be much contusion of the soft parts, leeches may be used with advantage. An endeavor should be made to mould the parts *very gently* into a normal contour, using, if necessary, adhesive strapping for purposes of retention. All food by the mouth must be interdicted and rectal enemata given. The symptom to be especially watched for is dyspnoea, and if this becomes threatening, tracheotomy may be necessary or an intubation-tube may be inserted. The latter has the advantage not only of supplying air, but serves as a splint around which the parts may heal. For this purpose a tube of a conical shape may be employed. Resulting cicatrices must be dealt with according to the requirements of each individual case.

Occasionally, apart from traumatic cases, patients may be seen in whom there is a luxation of the inferior horn of the thyroid cartilage forward from its articulation from the cricoid. It occurs during a deep inspiration, or more frequently in yawning, especially when the latter act is done in the recumbent position, and is therefore incomplete. It may happen on either side, recur frequently, then not again for a long time. Generally the pain from it is intense, though the condition is not attended by danger. Examination will show at the site of pain, on the inner side of the sternomastoid muscle, a slight prominence deeply situated at the level of the lower border of the thyroid cartilage. Downward and backward pressure will reduce it with a distinct noise, as may also a few efforts at swallowing. The predisposing cause is probably a loose capsule of the joint; the exciting causes are the contractions of the sternothyroid and cricothyroid muscles, the movements of the larynx being restrained by its attachment to the hyoid bone.

CHAPTER XIV.

CHRONIC INFLAMMATIONS OF THE LARYNX.

CHRONIC CATARRHAL LARYNGITIS.—The laryngeal mucosa may be the seat of a simple chronic catarrhal inflammation involving the entire lining or limited to certain localities.

Etiology.—This condition is set up by a great variety of affections. First of all may be mentioned abnormal states of the upper air-passages, which undoubtedly cause the majority of cases coming under observation. Particularly to be remembered in this connection are the common forms of rhinitis, both atrophic and hypertrophic, deviations of the septum nasi, chronic nasopharyngitis, enlarged tonsils, etc. All of these lesions interfere more or less with the proper functions of nasal and nasopharyngeal respiration, which are to warm, moisten, and purify the inspired air, and it can easily be understood how a vitiated air constantly passing through the larynx will gradually lead to chronic changes of a catarrhal type. Another cause is the constant inhalation of irritant substances, the most common being dust incident to various occupations. Concerning the effect of alcohol and tobacco in this direction, some extravagant statements have been made. Their excessive use is of course liable to set up chronic laryngitis, but this is because of previous involvement of other tissues higher up in the respiratory tract. In the vast majority of cases their moderate use does not seem to harm the larynx. It is difficult to obtain exact data on such points, for many cases of chronic laryngitis do not come under observation at all. A moderate degree of the morbid process is not incompatible with the proper exercise of the vocal organs in the ordinary requirements of life. It is only the professional voice-users to whom the question becomes a vital one.

Another class of patients who suffer from this form of throat disease is composed of those whose business requires them to make unusual vocal exertions under unfavorable circumstances. While speaking in the open air according to well-recognized oratorical methods is a valuable means of strengthening the voice, its constant use hour after hour in the open air, as in certain occupations, or to an immoderate extent, as in the case of a political speaker addressing large audiences, is attended by most harmful results. Finally, there is the large class of voice-users, such as singers, clergymen, actors, etc., who work under fairly favorable conditions, but who, as a result of wrong vocal methods or improper manner of breathing while actively engaged in their calling, constantly strain the delicate structures of the larynx, and so set up chronic catarrhal changes, these latter exciting causes existing in addition

to a possible abnormal condition of the passages higher up. There is no doubt that certain chronic visceral diseases exert an unfavorable effect upon the larynx, as do also various diatheses. While the importance of this class of causes may have been exaggerated, it is not to be overlooked. Gastrohepatic disorders are found in some sufferers from chronic laryngitis who quickly recover as soon as the offending tract is put in proper order. So also in the gouty and rheumatic poisons are found agents which may localize their action on the larynx.

Pathology.—Whatever may be the exciting cause of the disease, the results are eventually the same. The blood-vessels become permanently dilated, and the various changes normally going on at the surface and in the substance of the mucosa assume a hyperactivity. There are increased cell formation and desquamation and an increase of secretion. In the mildest cases very few changes are evident, the membrane being nearly dry from deficient secretion; this is more apt to occur when an atrophic condition of the rhinopharynx is the primary exciting factor. This dryness sets up an abnormal sensitiveness of the surface, to which are due the symptoms observed. If the case runs a long course there occurs later a thickening of the entire mucosa from the cell-deposit of connective tissue. This may produce either a uniform thickening or the surface of the mucosa may be irregular. The tubular glands and lymphatic nodes share in the process, and thus there may be a granular appearance of the membrane,—the laryngitis granulosa of some writers,—but there is no need to make a separate disease of this particular form. This later condition is essentially one of hyperplasia, and is more in evidence in the ventricular bands and arytenoid commissure. Changes in the vocal cords themselves consist mainly in increased vascularity. The activity of cell proliferation at the surface of the mucosa may lead to small erosions, which are recognized by the absence of that peculiar smooth, glossy appearance which normal cords covered with normal mucus present. These are always superficial, and heal readily.

A subvariety of chronic laryngitis is that known as pachydermia of the larynx. It consists of a thickening of the superficial epithelium and of the deeper parts of the mucosa, which presents itself in the form of elongated projections from the general surface. It is most frequently seen in the posterior commissure and the portion of the glottis between the arytenoids. It does not appear to have any relation to a special causation or diathesis. Varicosities of the small veins coursing over the ventricular bands are occasionally found.

Symptoms.—The most obvious symptom is a loss of clearness of the voice. Under ordinary conditions of life this may for a long time scarcely be noticed, but when any unusual or prolonged strain is put on the voice it is soon perceived. This huskiness will often improve for a while after taking food, or the voice may be clear for some hours in the morning, but gradually become hoarse towards night. If the sufferer be

a professional voice-user there may be no apparent hoarseness at first, but the range becomes diminished, the voice is less controlled, and becomes easily tired out. While there is no distinct cough, there is a frequent desire to clear the throat of the tenacious mucus which is apt to collect on the sensitive parts. Bosworth considers the existence of a true cough as evidence that the catarrhal process has passed beyond the limits of the larynx proper and has affected the trachea. The affection is not a painful one, except in so far as there may be fatigue after vocal exertion. There is apt to be more or less dysæsthesia in the larynx, especially a feeling as if the throat were being forcibly compressed.

Diagnosis.—This can usually be made by the rational history of the disease. In examining the larynx one finds a change in the color of the mucosa, which over the arytenoid commissure and ventricular bands is of a deep reddish hue and slightly swollen. A moderate quantity of thick, grayish mucus may be found irregularly distributed over the parts. While the changes just mentioned may have a patchy distribution, a condition of this nature strictly localized to one side should excite suspicion of a malady far more serious than mere catarrh. It generally signifies commencing infiltration, possibly from some peculiar diathesis, as tuberculosis, or perhaps more often from malignant deposit. Such cases should be most carefully watched, and all therapeutic measures employed with reference to the possible nature of the condition. Under such circumstances, also, the condition of the adjacent lymph-nodes should be carefully determined. The true cords are apt to appear somewhat grayish in contrast with the reddened ventricular bands above them. They may be slightly thickened and their edges present epithelial irregularities. The thickening of the mucosa prevents their proper approximation and causes imperfect tone formation. Moreover, as the result of the catarrhal state, various muscles become more or less parietic, notably the thyro-arytenoid, and thus ensue a lack of tension, a husky voice, and an elliptical appearance of the glottis. Of course, in making a diagnosis one must exclude the possibility of a tumor, an exudation, or a foreign body, any one of which may cause merely a hoarseness, without any additional change for a long time. Little, if any, danger exists that the condition now under discussion may lead to tuberculosis, or even predispose thereto, unless actual erosions are present. As the knowledge of the exact nature of tuberculosis has increased, it has been shown that the process is quite different from that of simple catarrh, and that the latter does not predispose to the former. Concerning catarrh in its relation to possible tumor formation, it may be said that it affords a favorable soil for the development of benign but not of malignant growths.

Prognosis.—This depends somewhat upon the cause in each individual case, and also upon the possibility of removing it. If this can be effected there is no logical reason why the disease should not be cured. It ought

not to be looked upon as an incurable malady, though it is freely conceded that treatment may be required for a long time, demanding great patience on the part of the physician and great fidelity on the part of the patient.

Treatment.—This should commence with the correction of all vicious habits of life and the relinquishment of all irritant ingesta, either of food or drink. During the stage of active treatment it is well to forbid tobacco, though its after-use in moderation may be permitted. The next step is to place the upper air-passages in good condition. Rhinitis must be treated, septa straightened, and lymphoid deposits in the pharyngeal vault or between the faucial pillars removed. Attention must also be paid to the lingual tonsil, as in many women at the middle period of life this structure is at fault and may affect the larynx. Relief of the foregoing conditions is frequently followed by the disappearance of all laryngeal symptoms without any special attention to the larynx. Generally, however, in a case of any duration, topical treatment of the latter will be necessary, and its employment may in any case hasten a cure. For local use an atomized spray of mild solutions is most advisable. The time-honored remedy is silver nitrate, not more than ten grains to the ounce. The tongue is held, and the tip of the spray-tube directed over the top of the epiglottis. Then, with the patient uttering a note of high pitch, the spray is driven into the larynx. If it be desired to reach the parts below, the spray is given during a deep inspiration. Other solutions available are zinc sulphate, ten grains to the ounce, copper sulphate, somewhat weaker, and alumnol, fifteen grains to the ounce. Benefit is sometimes obtained by changing from one of these solutions to another from time to time. Internal medication may be of some subjective benefit to the patient, as by means of expectorants, such as the muriate of ammonia and weak preparations of antimony, the secretion may to some extent be liquefied, and so conduce to its easy removal. When the condition spoken of above as pachydermia supervenes, it may be necessary to use solutions sufficiently strong to destroy the epithelial overgrowth. For this purpose zinc chloride, forty grains to the ounce, will answer. A more definite procedure is to use some acid, such as chromic or trichloroacetic acid, which can be fused on a flat probe. This enables one to confine the application to any given spot, and is free from the possible danger of invading other parts. When there is a general relaxation of the cords, application of a solution of equal parts of muriated iron and glycerin on a soft cotton brush will often re-establish the normal condition. Inhalations from steam atomizers are of little service in chronic laryngitis. The absolute necessity of rest of the vocal organs in singers and speakers is too apparent to call for more than mention.

ATROPHIC LARYNGITIS.—This name is given to a condition of the larynx in which there is a crust formation and deficiency of moisture.

The crusts adhere to the lining membrane of the larynx, much as do ozænatous crusts in the nose. The disease is known also as laryngitis sicca.

Etiology.—According to most authors, the condition is practically never found without a similar condition higher up. Shurly states that he has seen cases confined to the larynx in girls who were taking music lessons. Generally the nose is atrophic, and sometimes the nasopharynx also. The process in the larynx cannot be looked upon as one of mere extension, for there seems to be some inherent property in the laryngeal mucosa which leads to an abnormal dryness. Given this predisposition, it is easy to see how the local state will be aggravated by the inhalation of a vitiated air due to lesions in the parts above. The late J. C. Mulhall¹ described what he called "laryngitis hiemalis," a subacute catarrhal laryngitis in which the secretions were adhesive from the beginning. In Mulhall's view, the peculiarity of the condition was that the cases were seen only during the winter, and were distinctly without involvement of either nose or nasopharynx.

Pathology.—The changes are exactly analogous to those taking place in atrophic rhinitis, treated of in another section of this volume.

Symptoms.—During the day, when the laryngeal muscles are in frequent motion, crust formation is not so annoying, but at night the crusts tend to accumulate, so that on waking the patient finds his voice more or less impaired, and there may even be a partial dyspnoea from occlusion of the larynx. In addition, there is the natural desire to clear the throat, and, when this has been effected, the voice is again clear. The expulsion of the crusts may be accompanied by a little bleeding, and shallow erosions are left behind after their removal. They are of the same general appearance and odor as those seen under corresponding conditions in the nose.

Diagnosis.—The expulsion of crusts will direct attention to the seat of the malady, and by means of the mirror others can easily be seen lying in the larynx. The posterior portions of the larynx, especially the commissure, are the more frequent seat of the disease when the latter is above the level of the true cords. Crust deposit, however, is often confined to the subglottic region.

Treatment.—From what has been said as to causation, it is evident that the first thing to do is to put the nose and nasopharynx in good condition. This consists in remedying mechanical defects and in thorough, persistent cleanliness. The larynx may be cleansed by spraying with a weak Seiler or Dobell solution, which loosens the crusts and allows of their easy expulsion. Then follows the use of some weak alterative solution, or of menthol, which can be dissolved in a bland hydrocarbon such as albolene. Internal remedies do not seem to be of much service.

¹ Trans. Amer. Laryngol. Assoc., 1893, p. 51.

Potassium iodide and muriate of ammonia have been given, with the object of increasing secretion. Better results seem to have followed the muriate of pilocarpine.

NODULAR LARYNGITIS.—By this term is meant an exaggeration of the epithelial thickening which is frequently observed at the junction of the anterior with the middle third of the true cords. The disease is also called trachoma of the cords, singers' nodules, and chorditis tuberosa.

Etiology.—This condition is generally, but not always, confined to singers, and is the result either of overstrain or of faulty vocal methods. Moure has described a series of cases occurring in children from seven to ten years of age,¹ but even in them he attributes the disorder to the vocal excesses to which modern school methods often subject this class of patients. Botey² finds the condition more common in sopranos, less so in mezzo voices, infrequent in barytones, and rare in basses. He describes what may be styled a "prenodular stage," calling attention to the fact that in the head-notes of sopranos and mezzos only the anterior three-quarters of the cords vibrate. The higher the note the less, of course, the length of the vibrating medium, which with the very highest notes is reduced to a length of not more than eight or nine millimetres; hence there is an immense quantity of energy expended, during which the junction of the anterior third with the rest of the cord is the central point of an intense vibratory oscillation, the greatest amplitude of which is confined to a space of not over three millimetres. This is the exact seat of election of the singers' node.

Pathology.—From the foregoing explanation it is easy to see how voice-use during any condition of inflammation or swelling will cause the opposing points on the two cords to come in contact one with the other, and from the friction thereby produced set up irritation and epithelial proliferation. Another theory as to the production of these nodules is the outgrowth of the discovery by B. Fränkel, some ten years ago, of a gland situated in the cord, the duct of which opens in the membranous portion of the cord directly under its edge. Repeated histological examinations by various authorities have proved the existence of this minute structure, and secretion has been seen to issue from it during phonation; hence, if from any reason the mouth of the duct becomes stopped, there may be a swelling of the gland or a dilatation of the duct, forming a retention cyst, which, however, will often disappear under rest. Rosenberg³ has seen a broadening and thickening of the cord in the entire region of the pars libera, being especially noticeable at the edge. This condition may prevent perfect apposition with the opposite cord, and later connective-tissue formation may take place. The

¹ Rev. de Laryngol, 1896, vol. xvii. p. 145.

² Ann. des Mal. de l'Oreille, 1899, vol. xxv. p. 249.

³ Laryngoscope, 1899, vol. vii. p. 219.

friction of a nodule at a given site on the cord frequently causes the formation of one at the symmetrical point on the opposite cord.

Symptoms.—These consist solely of defective voice formation, there being no pain, cough, nor dyspnoea. The voice is husky, weak, and possibly aphonic, from imperfect approximation of the cords; its various finer qualities are lost, and its tone becomes uncertain. Singers, therefore, become nervous and apprehensive, and the condition is thus aggravated.

Diagnosis.—The mirror will easily reveal the site and nature of the difficulty. If it has persisted long, there may be some evidences of chronic laryngitis and imperfect tension of the cord, as mentioned under that condition.

Treatment.—While these nodules may persist for years without apparent increase in size, their removal is needful in those whose voices furnish their means of livelihood. Rest of the vocal organs is absolutely necessary. This will doubtless cure some cases of recent formation and due to glandular occlusion. It is this class of cases which is benefited by various vocal exercises following the initial rest. For the removal of a nodule, strong solutions of silver nitrate of a drachm to the ounce may be applied to the site, localized by means of a fine applicator. Perhaps fused chromic acid allows the caustic to be more definitely applied. The galvano-cautery point has been used for this purpose. Cutting forceps are recommended by some for the actual avulsion of the nodules. Botey records a recurrence of fifty per cent. when the galvano-cautery was used, but only twenty per cent. when the cutting forceps were employed.

VASCULAR ABNORMALITIES.

Anæmia.—Anæmia of the larynx cannot be considered as a separate malady, being merely one expression of the general anæmia attendant on constitutional dyscrasie. At other times it is of special importance in its relation to a possible lurking development of tuberculosis. Cases presenting distinct anæmia of the laryngeal mucosa, especially if associated with chronic laryngitis or aphonia, should be subjected to the most thorough general examination, the sputa examined for bacilli, and the case kept under careful observation.

Hyperæmia.—This condition is the forerunner of many inflammatory states, some of which have already been considered, while others, as syphilis and tubercle, are treated of later on. As has been stated, the larynges of many vocalists and of those engaged in certain occupations are in a state of continual hyperæmia without being in one of actual inflammation.

Laryngeal Hemorrhage.—Apart from those cases in which bleeding is merely an accompaniment of some specific process, as a foreign body, ulcerations, etc., there are cases in which the larynx is the source of

hemorrhage. This may be a feature of an acute inflammation, or of some chronic visceral disease like that of the liver or heart, or due to direct blood dyscrasiæ, including hæmophilia. The various forms of anæmia may manifest themselves in this way. A condition of chronic inflammation may predispose to this accident, the exciting factor being severe local or general overexertion.

Pathology.—This is suggested by the definition of the condition. There may be either an actual rupture of vessel-walls or a diapedesis. Hemorrhage may be concealed, the blood collecting under the mucosa and forming a hæmatoma or a submucous infiltration without any actual leakage. This form may result from vocal strain.

Where the blood escapes from the vessels there may be a very small area of leakage, even a single point. More often this site is located on either the ventricular bands or true cords. In many instances it is not possible to find any especial exciting cause, and it must be concluded that there is some alteration in the integrity of the vessel-walls, so that forces which under ordinary circumstances would not be sufficiently powerful to exert any influence are able to produce the accident.

Symptoms.—These vary according to the nature of the bleeding. If the hemorrhage be submucous there will be evidences of laryngeal irritation, together with more or less impairment of vocal function. Nothing about the subjective symptoms, however, suggests the exact nature of the cause. If the bleeding be actually an escape of blood to the surface, there occurs the familiar hæmoptysis. The blood generally comes up clear or mixed with mucus, and is scanty in quantity. A clot may so form in the larynx as partially to occlude the glottis and cause dyspnœa, but this is rare.

Under these circumstances it will at once be appreciated that the immediate task is definitely to locate the source of the hemorrhage. This is not always easy from mere inspection, because the constant movements of the throat will spread the blood irregularly around the region, whatever may be its source. Moreover, blood may trickle down from parts above and appear in the larynx; hence the examination should include the nose, and especially the nasopharynx and region of the lingual tonsil. In an ordinary pulmonary hemorrhage, if the throat be not too irritable to allow satisfactory examination, the irregular blood-clots can generally be seen on the sides of the trachea, while this is not ordinarily the case in laryngeal hemorrhage, in which the blood remains confined to the larynx. Careful inspection of the larynx will generally reveal the source of the bleeding, and examination of the lungs may assist in the diagnosis. In concealed hemorrhage the sudden onset and the appearance of a reddish swelling at some point on the laryngeal wall will clear up any doubt. Finally, it may be that in rare cases the location of the hæmatoma is such that it is not plainly visible, and the possibility of this fact should be borne in mind in endeavoring to account

for a sudden case of dyspnœa, and those rare cases due to menstrual disorders must not be forgotten.

Prognosis.—This is of importance merely with reference to the significance of the exciting cause, for laryngeal hemorrhage is never fatal.

Treatment.—This should be directed to the improvement of the blood condition and the visceral state which may underlie the hemorrhage. If the hæmatoma be large, the general rule of opening it and turning out the clot may be followed; if it be small, it may be allowed to absorb. Local rest must be enjoined, and ice-pellets should be freely used, together with the coil over the larynx if the bleeding be persistent. A mild diet should be observed, one free from all highly seasoned and irritant foods, and for a day or two one which includes cold food. The action of internal remedies or hæmostatic agents on the blood-flow, such as ergot, gallic and tannic acids, is very unreliable. Probably the best effect can be obtained from a full dose of morphine, with atropine given hypodermically.

Locally, one may use a mild astringent spray, as previously described. The drug combinations for this purpose are iron, alum, or the acetotartrate of alum, ten grains to the ounce, or the solution of iron persulphate, not over ten minims to the ounce. The use of tannin in these cases is not to be relied on, as recent experiments have shown that this agent precipitates the albumin of a part, and so forms a protective layer of tannate of albumin; hence the local application of tannin to bleeding vessels does not cause their contraction, but often their relaxation. In cases in which hepatic disease is present, the unloading of the portal system with a mercurial followed by a saline purge will at once suggest itself. A blister over the liver is often of service.

DISEASES OF THE EPIGLOTTIS.

While this cartilage is generally considered one of the laryngeal rather than pharyngeal structures, and shares in a general way in the affections of the former, it may be the seat of certain processes which entitle it to separate consideration.

Concerning its function there is still some doubt. It helps to prevent entrance of food into the larynx during the act of swallowing, but this lid-like action is not indispensable to life, for it may be removed either for purposes of experiment or by processes of disease without any great impairment of deglutition. It has been looked upon as a "sounding-board" for reflecting the vocal sound-wave to the pharynx, where it is in part articulated. If it be destroyed the voice becomes less distinct, and if its edges be irregular and jagged the voice may be distinctly rough and harsh.

The healthy epiglottis may assume various shapes, all of which are consistent with perfect function. It may be curved, angular, pendulous, or folded, and its edges may be smooth, serrated, or crenated.

The under or laryngeal is always of a redder hue than the upper or lingual surface.

It is unusual for the epiglottis to be the seat of primary affections, it being generally secondarily involved, as in lupus, tuberculosis, and syphilis, in which it presents the lesions of these respective processes. So far as concerns its mucous covering, it shares in the various catarrhal conditions of the pharynx and larynx. Its edges are sometimes compressed in enlargement of the lingual tonsil, forming the so-called "in-carceration of the epiglottis." The cartilage frequently responds to this irritation by growing larger, but resumes its normal size when the source of irritation is removed. Specific lesions of the epiglottis are considered under their respective headings, but certain independent conditions are occasionally found which may here be mentioned.

During the past few years various writers have reported a condition called by them "angina epiglottidea anterior," a term proposed by Michel in 1878. By this is signified an œdematous condition confined to the cartilage and usually to its anterior surface. The true cords may be reddened, but, as a rule, the larynx is not much involved, it being rare to find any general swelling of the entire laryngeal mucosa. It is perhaps an extreme view to regard this as a separate affection, for, so far as causation is concerned, it may be nothing more than one of the many varieties of œdema of the larynx.

Primary chondritis leading to ulceration and abscess is very rare, but that it does occasionally occur cannot be doubted.

SIMPLE ENLARGEMENT OF THE EPIGLOTTIS.—This is a pure hyperchondrosis, with more or less thickening of the mucosa covering the organ. The causes are in general the same as those which lead to pharyngeal catarrhs.

Symptoms.—It may be difficult to separate the symptoms of an enlarged epiglottis from those due to associated lesions, such as an enlarged lingual tonsil or a varicose condition of the lingual veins. There are found here the same round of painful pharyngeal sensations, irritative cough, involuntary swallowing, sensation as of a foreign body, vocal impairment, and irritability of the digestive organs. During exacerbations of the local inflammation of the overlying mucosa, painful swallowing is the most noticeable feature. The enlargement may be vertical or horizontal. The change in the organ is quite independent of changes in the larynx, and does not seem to depend on those causes which affect catarrhal states in general. The irritation at the bottom of this tumefaction may be the enlarged lingual tonsil, or possibly some congenital peculiarity of the epiglottis either in size or shape may lead to the primal irritation. Merkel showed thirty-five years ago that under normal conditions the margin of the epiglottis, when the organ covered the larynx during deglutition, escaped the posterior pharyngeal wall by a quarter of an inch. Frequently the least exciting cause, such as talking, singing, eating,

change of temperature or of posture, going out into the cold air, etc., may set up an attack of coughing, or render the voice temporarily incompetent for use.

Treatment.—All sources of irritation should be removed and an antiscatarrhal regimen established. Such measures, if faithfully carried out, will often permanently relieve the milder cases, while there are others which they fail to help. Astringent applications alone are of little use. Cocaine followed by an oily spray will relieve the symptoms, but its continued use is objectionable. The employment of the galvano-cautery to reduce the size of the cartilage is liable to be followed by severe reaction. Rice advises the trimming off of a strip about one-eighth of an inch broad from the margins of the cartilage where they impinge on the lateral pharyngeal walls, using for this purpose long, curved-handled scissors. Reaction is only moderate and hemorrhage is not excessive. Brown suggests as a suitable instrument a rectangular epiglottome in which the teeth merely transfix the cartilage without drawing it through the ring. In this way the portion to be removed is under the full control of the operator.

CHONDRITIS AND PERICHONDRITIS OF THE LARYNGEAL CARTILAGES.

The occurrence of a primary chondritis is denied by most writers, who look upon the condition as secondary to involvement of the perichondrium. The gradual ossification which the cartilages undergo from advancing years can hardly be regarded as a disease. The cases due to tubercle and to malignant disease are generally masked by the composite of these symptoms, and rarely assume the type of severity that is seen in other diseases.

Etiology.—Many of these cases are caused by exposure to cold and wet, others by various kinds of trauma, injuries inflicted during surgical operations, erysipelas, diphtheria, pneumonia, any of the exanthemata, and particularly those continued fevers and diathetic states which confine patients long to their beds. This latter variety has been ascribed to the pressure of the cricoid against the vertebræ in the recumbent position. Lennox Browne has described what was believed to be a condition of calcareous degeneration due to a gouty deposit in the epiglottis, with symptoms of enlargement of the right crico-arytenoid articulation, in a man of sixty-two, of confirmed gouty habit. He adds that in almost all perichondrial inflammations not the result of traumatism the disease commences in the neighborhood of this joint. Birkett,¹ of Montreal, has seen one case of disease in this locality which he believed to be the result of a local gonorrhœal rheumatism. Other cases due to ordinary rheumatism have been reported by several observers. In many instances the

¹ Trans. Amer. Laryngol. Assoc., 1896, p. 185.

morbid process may begin in the perilaryngeal soft tissues. Bresgen¹ finds a cause in overexertion of the vocal organs.

Pathology.—The condition begins with an increased blood-supply, followed by increased cell-production. Swelling results, followed by pus formation and the consequent separation of the perichondrium from the underlying cartilage. The latter becomes superficially eroded and in many places softened. Any or all of the laryngeal cartilages may be affected, though it is most usually confined to one. "Most authors appear to consider that caries is a *necessary* sequence of perichondrial inflammation; but this is certainly incorrect, for in not a few cases the inflammation terminates in resolution with more or less thickening and functional impairment, but without caries or separation of any portion of the cartilages" (Lennox Browne). It is possible, however, for portions of cartilage to become separated and then expectorated.

FIG. 252.



A. Perichondritis cricoidea. (Rosenthal.) The abscess projects beyond and beneath the left vocal band.



B. Perichondritis arytenoidea. (Rosenthal.) The left arytenoid has been separated and expectorated.

Symptoms.—The general symptoms are those of an acute inflammation, with chills and fever, general malaise, etc. Local symptoms depend somewhat on the special cartilage involved. There is a sense of fulness in the part, with tenderness on pressure, but pain is not a prominent feature in either the primary or secondary form of the disease. Cricoid disease especially causes dyspnoea, loss of voice, and possibly dysphagia if the part involved be posterior, thus affecting the oesophagus (Fig. 252, A). Thyroid involvement causes interference with the voice and with respiration. Cases are on record in which the pus has discharged through a fistulous opening in the neck. If the lesion be bilateral, phonation becomes impossible. If the inner surface of the cartilage be affected, dyspnoea becomes a prominent, and in cases of bilateral involvement an alarming, feature. If the arytenoid be affected, a swelling forms which interferes with both swallowing and breathing (Fig. 252, B). It is this form which causes the ankylosis of the crico-arytenoid joint, above noted. This, of course, affects the voice.

¹ Krank. des Kehlkopfs, 1891, S. 381.

Diagnosis.—This is a matter of some difficulty, even after a careful observation of the case. Frequent examinations will generally enable the observer to finally localize the seat of the disease. Initial symptoms may be simulated by a croupous laryngitis, but the type of general symptoms in the latter is rather more severe, and the exudation, if present, can usually be detected. Thyroid and arytenoid cases are usually diagnosed without much difficulty, while cricoid cases are extremely puzzling. The swelling will be seen without difficulty, but it may at times be impossible to say positively from which cartilage it springs. Fortunately, this does not affect the treatment, which is the same no matter where the focus of disease may be.

Prognosis.—Immediate danger to life is small. The cases run a protracted course, and there is ample time to prepare for emergencies. The eventual outcome is quite another matter, so far as concerns the retention of perfect laryngeal function. Cases affecting all the cartilages are, as a rule, fatal in a few months, but these are more often due to some underlying dyscrasia, which is the real fundamental cause of the fatal result.

Treatment.—This should be begun with the general measures applicable to inflammatory conditions, and the use of the ice-coil, leeches, or cups externally. Internally, ice-pellets should be freely used, and, if necessary, opiates may be given to quiet local distress. Cocaine spray, or, better in these cases, eucaine in, say, ten per cent. solution, may be employed. Potassium iodide is the only internal remedy which seems to be of any service. It should be begun in moderate doses, which should be continued for some time after the subsidence of acute symptoms, care being taken that it does not derange the digestive organs. A good plan is to slowly increase and then diminish the dose. If the cartilage dies, the progress of the sequestrum must be watched, for the sooner it can be removed the less liability there is to deformity. Various surgical procedures may be adopted, among which may be named dilatation in the later stages. Dyspnoea in the course of the disease may require tracheotomy or laryngotomy. The use of absorbent ointments applied externally does not seem to be of much benefit.

CHAPTER XV.

TUBERCULOSIS OF THE LARYNX.

THERE is no longer any doubt that tuberculosis may primarily affect the larynx, though many of the cases placed in this category do not present sufficient evidence to exclude the possibility of the existence of some other local deposit to which the laryngeal affection is secondary. Autopsies show various foci of the disease, so that it is not possible to say just where it begins. So far as the writer knows, no case of laryngeal tuberculosis has ever progressed to a fatal termination without evidence of invasion of other structures, though autopsies have sometimes shown the larynx invaded, but the lungs free. Most cases under this heading are secondary to tuberculous deposits, especially in the lower air-tract, or at least coexist with them, while other organs, such as the pharynx, palate, and nose, show by contiguity, and the liver, spleen, kidneys, and genito-urinary tract by metastasis, additional deposits. The existence of laryngeal lesions in connection with pulmonary tuberculosis was long recognized, without, however, any accurate idea of their true nature.

The frequency of the association of laryngeal with pulmonary tuberculosis has been the subject of much statistical research. Figures are variously given by different writers, but in a general way it may be said that while probably one-third of all pulmonary cases present laryngeal deposits, in only about one-eighth to one-seventh do the latter develop into active lesions leading to a progressive destruction of the larynx.

Etiology.—It is now generally agreed that the cause of tuberculosis is the invasion of the tissues by the bacillus of Koch; but there must be, in addition, a peculiar receptivity of the tissues, which may result from any one of a large group of factors, including heredity. This bacillus is responsible for about one-seventh of all deaths from all causes combined. Autopsy records at any of our large hospitals show that every third or fourth cadaver reveals (regardless of the exact cause of death) evidence of healed or active tubercular disease, generally in the lungs. The enormous prevalence of this particular micro-organism is at once apparent, and it can hardly be doubted that every one receives, at some time or other, a dose of the tubercular poison, which, if his system offers the necessary receptivity, will result in an active outbreak of the disease. These observations apply especially to general infection, which localizes itself in the lungs more often than in any other organs. The most vulnerable portion of the pulmonary structure appears to be the posterior part of the apices, possibly as the result of the direct discharge of infected chyle

into the vena cava, the poison having probably entered the system through the food, or through moist germs swallowed or inhaled, or possibly through the infection of the tonsillar tissues.

In primary cases the infecting material may either find direct lodgement on the laryngeal mucosa, or may be brought thereto by vascular channels, probably the lymphatics. Korkunoff¹ believes that an immense majority of bacilli are carried from the pulmonary foci by the blood- and lymph-vessels into previously dilated subepithelial lymph-spaces of the mucosa, and that they penetrate the epithelium from without only in some of those exceptional cases in which there has occurred from other causes some solution of continuity which offers to the bacilli in the sputa a portal of entrance. It cannot be doubted, however, that bacteria do get through the epithelial cells, though in many instances they seem to be destroyed by phagocytosis. Richard Lake² believes that many micrococci, ordinarily at rest on the surface of the epithelium, find their way during coughing attacks and during sleep into the interstices between the cells. Some are removed by phagocytosis; others, by virtue of their overwhelming numbers, establish themselves, and by cell-destruction lead to the formation of small abscesses. These rupture, their bacterial contents being still non-tubercular; but the abscess cavities increase in depth, and by the time the submucous tissue is reached infection by the tubercle bacillus occurs. It is certainly a striking fact that the most frequent site of inoculation corresponds with the most frequent site of erosions, both being the anterior aspect of the arytenoids and about the posterior insertion of the true cords.

As to the increased likelihood of infection in a larynx previously the seat of catarrhal disease, it may be said that this exists mainly when the catarrhal process has led to erosions, probably rarely otherwise. Naturally an inflamed structure is more liable, in consequence of its temporarily lowered vitality, to invasion by any deleterious agent than is one perfectly normal; hence chronic catarrhal states of the mucosa of the larynx and adjacent structures can be regarded as definite predisposing causes. All depressing habits, such as alcoholic excess, over-use of voice, etc., may be included in the same category, but only through the antecedent stage of catarrhal inflammation leading to erosions. Syphilis may coexist with tuberculosis. Notwithstanding all these facts, it must be admitted that, on account of what is called "tissue-resistance," the larynx enjoys a remarkable immunity from tubercular deposit when one considers the assaults to which it is exposed. The affection is more common in men than in women. Young adults present by far the largest number of cases, but this is the age at which pulmonary tuberculosis is most common. Certain occupations, such as those attended by much

¹ Deut. Arch. f. Klin. Med., 1889, Bd. i. Heft 2.

² Amer. Jour. Med. Sci., April, 1895, p. 407.

exposure to dust-laden air or by confinement in poorly ventilated working-places, bring the system into a receptive condition.

Pathology—The alterations at the affected site resemble in a general way tubercular changes in other structures. Often there appears to be a stage of preceding inflammation, due to the indirect influence of the tubercular diathesis before the actual deposit of tubercle. The changes begin with a dilatation of the blood-vessels and lymph-channels, with some proliferation of the white blood-cells and of the lymph-cells which resemble them, an increase in the wandering cells of the connective tissue, and the mesh-work of the tissue becomes more or less œdematous. If the infection continues, or becomes more severe, there may be a small-celled infiltration; but up to this point resolution is possible, or fibrous changes may be set up, so that the process comes to an end. Ulceration is very uncommon, and unless it occurs it is very difficult, if not impossible, to find bacilli in the sputa.

When actual tubercle is formed, those points on the mucosa at which lymphoid tissue is abundant suffer especially. The deposit is formed in the membrane proper, and for a while the epithelium remains unchanged. The most frequent sites of invasion are the posterior commissure, mucosa of the arytenoid cartilage, ary-epiglottic folds, true cords, and epiglottis. The acini of the tubular glands seem to be especially vulnerable. Gradually all the laryngeal structures are invaded, but the crico-arytenoid joint generally escapes actual deposit. After the process is fully developed there are found the ordinary tubercles, at first scattered, but later coalescing into masses visible to the eye. They consist of portions of granulation-tissue surrounding giant or epithelioid cells, and are in turn themselves surrounded by a zone of round-celled infiltration. The tubercle itself is non-vascular, so that there is an early tendency of the structure to break down, and at the same time the small arteries going to the invaded area become the seat of an obliterating endarteritis. As a result, there are a localized necrosis, a subepithelial erosion, and finally a penetration of the surface layer and the discharge of nodular contents, the cheesy softening thus leading to the formation of an ulcer. This is minute at first, but gradually coalesces with its fellows until a large area is affected. The tubercular deposit may at the same time work deeper and extend to the cartilages.

Microscopic specimens will show the presence of the tubercle bacilli, especially during the earlier stages of the cheesy softening, when they are, as Lennox Browne suggests, perhaps more easy of detection, owing to their greater selective affinity at this time for staining agents. When

FIG. 253.



Tubercular infiltration of the larynx.
(Grünwald.)

the process is not too extensive in area, nature endeavors to circumscribe it, and not infrequently succeeds, for one often sees tuberculosis arrested in the larynx, though the systemic deterioration from pulmonary or other tubercular lesions may steadily go on. The peritubercle tissue shows great vascular activity and a formation of fibro-connective tissue which is nature's barrier. In fact, this process suggests the proper method of cure, so far as local disease is concerned. Viewing the process from a purely clinical stand-point, the first change from the normal is in the vascularization of the mucosa of the larynx. In the ordinary chronic form of the disease it becomes distinctly anæmic; the mucosa of the

entire throat may also be anæmic. This general pallor is most suspicious, and should always lead to a most thorough examination of the chest, and the patient should be kept under close observation. Most cases, however, will show by the time they first come under observation unmistakable evidences of infiltration with more or less swelling. As before stated, this most frequently appears in the interarytenoid space, but in many voice-users it first appears on the cords, rarely in the epiglottis. The result of this infiltration is to prevent free movement of the various muscles of phonation. Interarytenoid deposit naturally affects the adductors, while infiltration of the crico-arytenoid joint acts in a similar way, though the joint generally escapes actual deposit. In some instances, where there is no actual obstacle to proper cordal action,



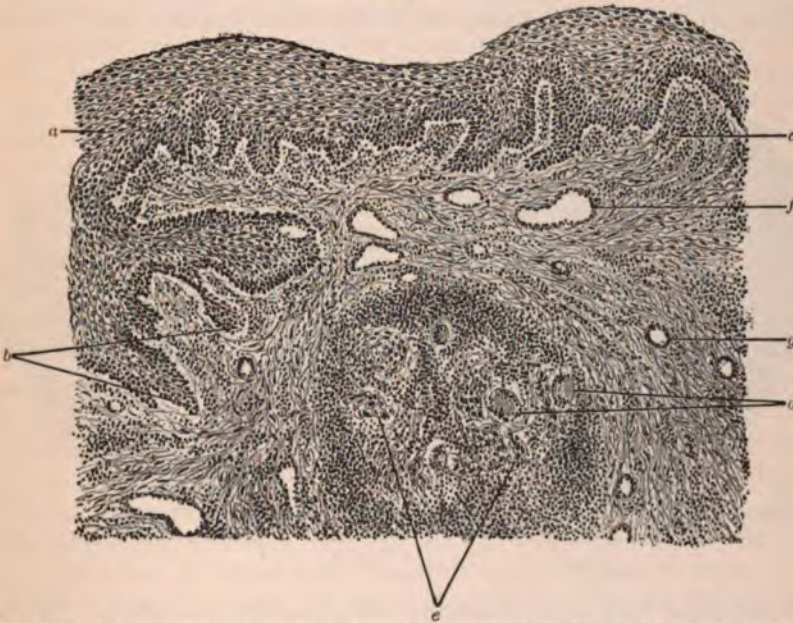
Section through the right aryepiglottic ligament. (Rosenthal.) a, a, tubercle; b, mucous glands.

the patient seems too weak to properly use the muscle, that in turn may sometimes suffer from actual tubercular deposit. Following this stage of infiltration, there ensues that of breaking down or ulceration. The peculiarities of the tubercular ulcer have been described when speaking of the localized process in the pharynx. It is shallow rather than deep, is covered with thick, ropy mucus, and no very marked boundary exists between the edges of the ulcer and the surrounding area (Fig. 256).

Under the conditions named the vast majority of ulcerations are of a tubercular nature, but there are others which are simple erosions, due probably to irritation from sputa, and must not be looked upon as the

portals of the original infection. Succeeding the ulceration is the invasion of the cartilages, which, however, is not always evident on inspection during life. Rarely in proportion to the whole number of cases is there any actual extrusion of cartilage, though occasionally a complete cartilage with carious surface has been expelled, especially the arytenoid. If chondritis or perichondritis be set up, there are seen the usual features of this condition. The exact nature of the disease is determined by the association of the local process with the general tubercular state. Finally, there is a rare class of lesions, consisting of tumors,—tuberculomata,—which are of great interest from a histo-pathological point of view. The

FIG. 255.



Tuberculosis of the larynx. (Selfert and Kahn.) *a*, epithelial covering, thickened; *b*, involutions of the same into the subepithelial connective tissue; *c*, cellular infiltration of the latter; *d*, tubercles with giant cells; *e*, tubercles with epithelioid cells; *f*, dilated vein; *g*, artery.

growths appear as smooth, rounded tumors, single or multiple, or sometimes merely as papillary excrescences (Fig. 257). Examination shows them to consist of tubercular tissue generally containing the bacillus, but accompanied by only slight evidences of tubercular infection in the lungs or elsewhere, and at times by no such evidence.

J. N. Mackenzie believes such growths to be "anatomically allied to granulation-tissue and a natural step towards cicatrization." Wart-like excrescences are frequently found in the interarytenoid tissue, and several writers attach great diagnostic value to their recognition. Browne dissents from this exclusive view, stating that they "are quite as often

seen in connection with syphilis or even in chronic laryngitis independently of any specific dyscrasia." Tuberculomata of the trachea have been described by Ariza and J. N. Mackenzie.

Symptoms.—The most common initial symptom is impairment of vocal integrity. At first, speaking may be simply difficult without noticeable alteration of tone, and apparently due only to impairment of thoracic expulsive power. Nothing abnormal is found on examination. Such slight symptoms are of significance with reference to tubercular disease only in connection with evidence of lesions elsewhere. Instances of eunuchoid voice have been reported by Castex¹ and others. If the local process has gone on to actual infiltration sufficient to prevent perfect approximation of the posterior ends of the cords, there are varying degrees of hoarseness corresponding in a general way to the extent of the lesion. Browne

FIG. 256.



Tubercular infiltration and ulceration. (Grünwald.)

FIG. 257.



Diffuse tuberculous infiltration of the entire larynx, and tuberculous tumor formation. (Grünwald.)

calls attention to a vocal condition not generally described. "This is found in the rapidity with which the voice changes in character during a short conversation from a gruff hoarseness to a high falsetto, which as quickly passes into a toneless whisper." This variation is doubtless due to lodgement and dislodgement of secretion and also to peripheral nerve irritation affecting the tension of the cords. Minor vocal changes are the same as in congestion from any cause, and the voice may show periods of freedom from any impairment. Another early symptom is cough, at first dry, and coming on in a jerky manner whenever the patient attempts to speak. At times it is like that of pertussis, followed or not by expectoration and frequently by vomiting. This stage is often associated with intralaryngeal irritation as from a foreign body. Later, cough

¹ Compte rendu de la Soc. Fran. de Lar., 1896.

becomes more pronounced and is accompanied by the accumulation of thick, tenacious mucus, requiring considerable effort to dislodge it. The cough gradually becomes like that due to pulmonary disease, when the sputa assume a mucopurulent or purulent character. *Hæmoptysis* is not a common feature of tuberculosis of the larynx, and does not show itself until the ulcerative stage has been reached. The quantity is always small unless the lung be coincidentally involved. Occasionally it is possible to detect the exact site from which the blood comes.

Local pain, with tenderness on pressure, may be present, both especially severe if the cartilages have become involved. They are slight, even in cases of extensive lesions, provided the cough is not severe and the patient is not attempting to swallow, conditions which very seldom exist. The *painful swallowing* met with in the last stages of the disease is notoriously common, and forms a most unhappy feature of the case to both physician and patient. The former is powerless to arrest it, except temporarily and to a slight extent, while the act of swallowing causes the patient so much pain that he prefers to starve rather than take nourishment. Even when deglutition is not actually painful it is difficult, as, owing to the infiltration of the epiglottis and adjacent parts, their functional accuracy is interfered with. Breathing is not, as a rule, early interfered with from purely laryngeal lesions. In the later stages there may be more or less dyspnœa if the free motion of the cords becomes impaired, especially by a lesion which may keep them partly approximated, or when there is some growth obstructing the free passage of air through the larynx. The encroachment on the lumen of the passage may be so great as to necessitate tracheotomy.

The general symptoms are the same as those of active tuberculosis in any part of the body,—fever, sweats, emaciation, anorexia, rapid pulse, etc. In a suspicious laryngeal case it cannot be too strongly insisted upon that during the early stages, when the diagnosis may be uncertain, the chest must be repeatedly examined and comparisons made of the results. Perhaps at first the physical signs may hardly be of significance, but as repeated examinations are made and the symptoms become more developed, one can arrive at an accurate idea of the nature of the laryngeal lesion even though the latter may have been stationary. The sputa should be examined repeatedly according to methods now in vogue.

These patients are frequently hopeful and energetic, and the very mild local symptoms in many cases are apt to mislead even the physician, who may attribute them to some catarrhal process in the passages higher up or to some other constitutional dyscrasia, not suspecting tuberculosis.

Differential Diagnosis.—Given such a group of symptoms as above described, a case of laryngeal disease suggests three special maladies,—malignant disease, syphilis, and tuberculosis. In syphilis there is apt to be a husky and hoarse rather than an aphonic voice, and pain is an

infrequent feature. Inquiry must be made as to the history of initial infection and the usual development of the different stages. Finally, there is the therapeutic test of potassium iodide, during which the patient must be closely watched, because sudden and even dangerous œdema is known to have followed its use.

Malignant disease presents its own dyscrasia and pain is a pretty constant feature. Examination of the lungs is negative, and no bacilli are found in the sputa. If there be a general infiltration there may be an immobility of one side of the larynx, and if the growth be of such a shape that removal of a piece is possible, examination by the microscope may at once settle the diagnosis. Later stages will be attended by ulceration and a foul discharge, but it is in early diagnosis that the difficulty lies, and the latter cannot always be made until the case has been watched for a time and the local changes closely noted. In tubercle, especially when supervening on disease of the lungs, the diagnosis may often be made from the history of the case, but the mirror enables the surgeon to

determine the site, extent, and degree of the local change. A pallor of the mucosa is always suspicious. At first there may be only the usual changes of catarrhal laryngitis, but the local changes are not evenly distributed as in that affection, and are more apt to be confined to the aryepiglottic folds and ventricular bands. Sometimes there is a warty appearance in the interarytenoid commissure, and it may be possible to recognize tubercles through the epithelial layer of the mucosa.



FIG. 258.
Thickening of the epiglottis and arytenoid cartilages; disease at left apex; subject of tuberculous laryngitis. (Lennox Browne.)

In the second stage there is noted a tumefaction of the covering of the arytenoid cartilages and of the aryepiglottic folds, giving the "club-shaped" arytenoids. It is rare to find only one side thus affected, though both may not be equally involved. The finding of this condition is of the greatest significance, for while there may be at this point localized œdema under various circumstances, the persistence of the lesion in association with other and constitutional symptoms renders the diagnosis positive. It is in the early stages of these cases of unilateral infiltration that diagnosis is difficult. An aid to diagnosis is the condition of the epiglottis, in which the infiltration is deposited along its crescentic edge, giving it a turban-shape.

Ulcerations may now appear, starting as minute points, but gradually coalescing and finally covering extensive areas. The tubercular ulcer does not markedly differ in color from surrounding areas of infiltration; its surface is slightly uneven. Unless the process has invaded the epiglottis and true cords, the loss of substance does not appear very noticeable, but if such invasion takes place the tissues seem gradually to disappear

by a slow melting away. Finally, if any of the cartilages become necrosed and exfoliated, there occur varying conditions of distortion of the parts occasioned by their loss.

Prognosis.—This is, of course, always unfavorable, but cases of recovery from the local lesion have been reported. This is one of the more hopeful features of the progress in therapy during the last few years, for physicians have learned that much may be effected by energetic intervention, and they no longer content themselves with merely palliative routine measures. Cohen estimates his own recoveries as one per cent. of the total number of cases seen by him. Recovery in this sense refers to the ability to resume occupation and to live for a varying number of years, or, as stated by Delavan, "to call that case cured in which all trace of active disease has disappeared from the larynx and all active symptoms referable to that organ have passed away, particularly in which there is no recurrence of the local lesion during the remainder of the patient's life." Robert Levy¹ would go a step farther and "call a case cured in which all active indications of disease fail to recur after two or, in some instances, one year from their cessation." Levy's figures from his own experience are of interest. He conditions the prognosis on the nature and position of the lesion, combinations of lesions, pulmonary condition, coexistence of syphilis, and treatment. Out of one hundred and forty-four cases, of which eighty-four were of the infiltrative and papillomatous variety, twenty-six were at time of writing either worse or dead, but only eight of the twenty-six were influenced materially by the laryngeal complication. The remaining fifty-eight either got better or completely recovered. Out of sixty cases of the ulcerative variety, thirty-seven grew worse or died, twenty-nine being hurried to an unfavorable ending by the laryngeal state. As regards the position of the lesion, he makes a general division into two classes,—those with intact epiglottis and aryepiglottidean folds, and those in which one or both of these structures have been invaded; of one hundred and three of the former, all grew worse or died, and of forty-one of the latter, twenty-nine died. The presence of œdema, acute tuberculosis, or tuberculosis of the pharynx decreases the chances of recovery. Pulmonary lesions, of course, do the same, though, as above stated, it is possible for the larynx to heal while the lesion of the lung tissue steadily progresses. As to the coexistence of syphilis, he agrees with Schech that the prognosis becomes the more unfavorable as the tuberculosis gets the upper hand.

The importance of an early diagnosis with reference to the detection of tubercular disease cannot be too strongly insisted on, and the survey of the field in each case must be a broad one. Lennox Browne² urges that "it is as important to examine those portions which lie above the

¹ Jour. Am. Med. Assoc., September 16, 1899, p. 707.

² Jour. Laryngol., May, 1900, p. 274.

larynx suspected of being the subject of tuberculosis or pretubercular disease as to examine the lungs. For, as has often been pointed out by others than myself, the little cloud predicting a storm can be often seen by the eye before the ear will hear the thunder." Such an examination will occasionally reveal some cause of irritation (such as an enlarged uvula) in a case presenting all the subjective and some of the objective evidences of incipient tuberculosis. Removal of the cause leads to a subsidence of all symptoms. The use of tuberculin in these early cases as a means of diagnosis has never been relied on to any great extent, at least in America. There can be no doubt, however, that it is an agent of considerable value. In the disappointment at its failure as a therapeutic agent, physicians have lost sight of its real value as a means of diagnosis. Caution as to initial dosage must here especially be insisted on, as tuberculin injections have in some cases led to a temporary aggravation of the local condition, and, according to Browne, in two instances to an ulceration where previously the condition had been one of infiltration only.

It must not be forgotten that with laryngeal as with pulmonary tuberculosis the later stages present the problem of mixed infection, for the destructive processes and accompanying inflammations are largely due to pus cocci, and the hectic features to the absorption of the toxins of these organisms far more than to those of the tubercle bacillus.

Treatment.—This may be considered under the headings of hygiene, diet, climate, internal medication, topical applications, and surgical measures.

Hygienic treatment is naturally the same as that prescribed for general tuberculosis. Care must be taken that the skin is kept in healthy condition by daily bathing. No general rule can be laid down as to the temperature of the bath, as each case must be dealt with by itself. The aim should be so to arrange the details of the bath that the patient shall react well. The underclothing should be of wool suited in weight to the season and should be worn in the common combination suit. As much time as possible should be spent in the open air, and gentle exercise should be a part of the daily treatment. If there are sputa, the same care should be followed in their disposal as with the pulmonary cases, even though examination should not disclose bacilli. They should not be swallowed, but deposited in some cheap receptacle which can be burned together with its contents. The patient should live in well-ventilated rooms, the sleeping-room not being occupied in the daytime, if such an arrangement can be made. As much rest as possible should be given to the larynx and to the entire body.

The food should be bland and unirritating, and in the earlier stages no special restrictions need be enforced except the avoidance of pastry, sweets, and other articles liable to derange the stomach. In the later stages the preparation of the food becomes a most important problem,

owing to the great pain in swallowing. It should be concentrated, bland, and unirritating, and in many cases it becomes necessary to employ some form of local anæsthesia before the taking of food. For this purpose sprays of cocaine or eucaine have largely superseded the use of morphine, antipyrin, and similar substances. More recently, however, a newer remedy (orthoform) has been shown to be of the greatest value in the relief of the odyphagia of laryngeal tubercle. Orthoform is a whitish-yellow powder without odor or taste, and soluble in alcohol and hot water. It is a product of organic chemistry, being technically known as the methyl ester of para-amido-meta-oxybenzoic acid. Its slow solubility is one of its special advantages, and it is in a general way anæsthetic and analgesic, and is believed to act on exposed nerve-endings. It can be freely insufflated in powder directly upon the laryngeal ulcers or can be applied by carrier in some form of mixture. Combinations with menthol have been found of service, and Freudenthal¹ recommends the following emulsion: menthol, 10; ol. amygd., 30; vitelli ovi (two yolks), 30; orthoformi, 12; aquæ dest., 100. This may be applied either with a cotton carrier or, as Freudenthal suggests, syringed directly into the larynx. While some cases of dermatitis have been reported after the use of the remedy in external wounds of large area, no untoward results have followed its application in the larynx. It is a valuable addition to the physician's resources in this distressing condition of odyphagia.

Another device, first published by Wolfenden, who received the suggestion from a patient, is that of having the patient lie flat on his stomach, with his head over the edge of a couch, and draw up through a tube liquid nourishment from a vessel at a lower level,—*i.e.*, drink as a horse drinks. It is found that many patients can in this way swallow with comparative comfort, when in the erect posture the act is agonizing. Still another plan that may be of service is the use of the soft-rubber catheter passed into the œsophagus, and through which, either by means of a rubber bag or funnel, nourishment is poured, or to which is attached the tube from a forcing-bottle, so that the food is in a way pumped into the œsophagus. All the foregoing must be looked upon, however, only as temporizing measures, serving to make the last days of the patient comfortable.

Climatic treatment does not seem to have any special effect upon laryngeal tubercle apart from that on tuberculosis generally. What will benefit the latter will, of course, benefit the former, and the improvement in the two conditions will go on *pari passu*. Removal to a proper climate does not annul the possibility of the development of laryngeal disease. Bad cases of the local disease ought not, even if the general condition be fairly good, to be turned loose in any climate, however ideal, but should be treated in sanatoria in favorable places. Much can be done with

¹ Philadelphia Med. Jour., March 25, 1899, p. 688.

fresh-air measures, even when the patient cannot leave home. If the house has a veranda, it can be sheltered by movable partitions or sides, so that the patient can remain much of the time in the open air, but must be well wrapped up and the feet kept warm. No remedy has yet been found which seems to have any special effect upon laryngeal tuberculosis apart from its effect upon the general condition. This is only what might be expected, for physicians must look upon the laryngeal condition as merely one of the many expressions of the general diathesis, modified only by local anatomical and physiological conditions. No remedy specific against tuberculosis has yet been found. Hypodermic injections with various tuberculins, serums, and other compounds are vaunted from time to time, but soon fall into oblivion: the excellent results ascribed to most, if not to all, of them cannot be verified. It is fortunate indeed that the profession has passed from the era in which the only remedies were quinine, iron, and cod-liver oil to a period of more active therapy. Yet the results obtained in these later years have come about more, perhaps, from the treatment of the patient than the treatment of the disease,—that is, so far as the general diathesis is concerned. All have learned the valuable lesson that digestive power and bodily energy are to be kept at their best, and that anything militating against these cannot be a rational therapy against the ravages of the tubercle bacillus.

Passing to the consideration of definite internal remedies, it may be noted that Shurly¹ states that he has found the iodine compounds more serviceable than any others, and he adds the valuable suggestion that the associated or combined administration with some proteid material is of great utility. He advises the use of guaiacol, creosote, or iodine preparations in either bouillon or milk.

There is no doubt in the writer's mind that valuable results are obtained by the use of creosote, though opinions may differ as to whether it has any specific effect or acts merely as an efficient intestinal antiseptic under the conditions considered. It can be given in pill form or in that of one of the various preparations which have been devised by manufacturing chemists, such as creosote with liquid peptonoids. Little is to be gained, and perhaps much is lost, by endeavoring to saturate the system with the remedy, or by seeing how large doses the stomach can tolerate. Much more benefit, it would seem, is derived from cod-liver oil nowadays than formerly, for improved methods of preparation have produced emulsions in which the oil is much more finely subdivided than before, and the absorption of it is therefore more complete. Other familiar remedies are the various hypophosphites and similar preparations. It is well to vary the combination given from time to time, so as to prevent gastric disturbance.

¹ Amer. Text-Book of the Eye, Ear, Nose, and Throat, p. 1048.

For the cough there is, in addition to the old and time-honored combination of remedies, a new substance (heroin), a derivative of morphine. The dose is from one-twelfth to one-sixth of a grain every three or four hours. Too large dosage may occasion drowsiness and constipation with some giddiness and depression of the respiration. Ordinary dosage is free from these effects, and the remedy does not derange the stomach. In some instances cough is relieved by taking thirty or forty drops of a mixture of equal parts of the fluid extract of ergot and hydrastis in a little water four or five times daily after eating. If cocaine is to be used to relieve the irritability inducing cough, an excellent combination is made of sixteen grains of cocaine with eight grains of resorcin in one ounce of water. The resorcin prevents the cocaine from crystallizing and the solution from decomposing, while it seems to increase the anæsthetic and diminish the toxic power of the cocaine. The addition of two per cent. of sodium sulphate to a five per cent. solution of cocaine decidedly increases the effectiveness of the latter, partly by reason of its penetrating power and partly owing to its action upon the globulins and other proteids which occur in the secretion (Wyatt Wingrave).

The topical treatment needs to be carefully carried out in order to make the patient as comfortable as possible, even if it does not check the general deterioration in health. When a patient first comes under observation, the throat is often so irritable that little can be done even in the way of examination, much less treatment. Under these circumstances he should be placed on the treatment suggested under the head of acute laryngitis until the local irritability has subsided and the physician is able accurately to locate the lesion and decide upon the plan of treatment. Local cleanliness must form an essential part of whatever plan is adopted. Several times daily the larynx should be sprayed with a solution of hydrogen dioxide (which can be diluted with lime-water) or with a solution of enzymol, which is a proteolytic ferment of much value in clearing away dead tissue. It should be diluted with an equal part of warm water, and can be sprayed in freely. It has but a slight and in no way disagreeable taste, is non-irritating, and does not act on living tissue. The author believes it to be superior to hydrogen dioxide for this purpose. This is to be followed by some warm dilute alkaline solution, as Dobell's, the Seiler tablet, listerine, etc., to thoroughly clean the affected part. Then, if there be merely an infiltration, some alterative solution, such as Mandl's (iodine, five grains; potassium iodide, ten grains; carbolic acid, two minims; glycerin, one-half ounce), may be applied, and a powder composed of equal parts of bismuth subnitrate and iodol immediately insufflated. The oleostearate of zinc, a white, creamy preparation, may be used as the vehicle for various alterative drugs.

Menthol has long enjoyed a favorable reputation. It may be applied in a twenty per cent. solution in olive oil by either cotton carrier or spray. While the number of cures reported from its use is very small, there is a

consensus of opinion as to its value in relieving the severity of all the local symptoms. Iodoform also enjoys considerable favor. The surgeon may, however, obtain equally good results with some other combination of iodine, such as iodol. The list of remedies of this class includes also europen, thiocol, and peronin. Another useful compound for application to an extensively ulcerated surface is made up as follows: morphine muriate and cocaine muriate, of each, one-quarter grain; boric acid and iodoform, of each, one grain; the whole to be insufflated two or three times daily. It may be given before meals to relieve dysphagia, or at bedtime to induce sleep. As long, however, as the use of morphine can be avoided, the better for the digestion. Lactic acid, being generally used in connection with curetting, will be considered in the following paragraphs.

Surgical Treatment.—Tracheotomy is occasionally necessary for the relief of dyspnoea due to oedema. It should be performed as low down as possible. It is merely a palliative measure, though a few cases have shown remarkable improvement in the intralaryngeal condition after the organ has been placed at rest by the operation. Life is prolonged and the patient made more comfortable. Extirpation of the larynx, once proposed, is not to be thought of in this connection. Of the measures designed for the interior of the organ, there may be mentioned first the method of incision of the oedematous tissues by means of knives or curved scissors, suggested by Moritz Schmidt and others some fifteen years ago, and later it was considered well to apply lactic acid to these incisions. Incision is followed by the escape of blood and serum, and the procedure seems to give considerable relief to local symptoms.

Heryng has suggested the injection of lactic acid into the diseased tissue, but this is a painful method and has given way to those now to be mentioned. These are the scraping or curetting of the ulcer, suggested by Heryng, followed by the application of lactic acid well rubbed in and the cutting away of diseased tissue by means of sharp spoons, as suggested by Krause, who also uses lactic acid after the operation.

The literature on this form of treatment has now become very voluminous, and there seems no reason to doubt that the foregoing method, modified, perhaps, in minor details to suit individual cases, offers the best means at one's disposal for the healing and possible cure of laryngeal tubercle. Heryng's¹ views have been summarized by Gleitsmann² as follows. Curetting and the use of lactic acid are indicated: (1) In cases of primary tuberculosis without lung complication. (2) In cases of lung disease either incipient or at least short of softening and hectic. (3) In circumscribed ulcerations and infiltrations. (4) In the dense hard swelling of the arytenoid region, the ventricular band,

¹ Jour. of Laryngol., 1893, p. 361, and 1894, pp. 193, 227, 471.

² Trans. Amer. Laryngol. Assoc., 1895, p. 136.

the posterior wall, tubercular tumors, and affections of the epiglottis. (5) Even in advanced pulmonary disease it is a justifiable measure for the relief of the intense dysphasia.

The curettes in most common use are the single instrument of Heryng for cleaning ulcerated surfaces and his rotary instrument for the excision of tubercular infiltrations. A double curette for the latter purpose has been devised by Krause. Local anæsthesia is secured by cocaine. If the operation be at all extensive, it is better to perform it in a hospital, where the patient should remain for a few days and rest where aid can be promptly summoned in case any emergency arises. Lactic acid should be rubbed in at the time of operation, commencing with a watery solution of ten or twenty per cent. and gradually increasing it up to sixty

FIG. 259.



Heryng's laryngeal knives and curettes.

or eighty. Botey has recommended an application of one part of lactic acid, two of carbolic acid, and twenty of glycerin, cocaine being previously applied. This preparation is somewhat emollient and more adherent than an aqueous solution. The strength of the acid is gradually increased as tolerance is established.

Mention should also be made of the submucous injection of creosote by means of a long, curved needle attached to a suitable syringe. Chappell prefers for this purpose the following combination: beechwood creosote and oil of wintergreen, of each, two drachms; hydrocarbon oil, one drachm; castor oil, three drachms. He has devised a special syringe which discharges its contents quickly by means of a spring action.

The use of the galvano-cautery is not to be advised, though it has had its advocates. In the hands of some clinicians, electrolysis has yielded

very fair results. W. Scheppegegrell,¹ among others, has recommended cupric interstitial cataphoresis under direct laryngoscopy. He states the following as the advantages of this method. (1) There is no real destruction of tissue, so that no new areas are opened for possible re-infection, as with curettage, the galvano-cautery, and simple electrolysis. (2) There is no reaction or hemorrhage. (3) There is no high degree of manipulative skill required as in some of the other methods. (4) The plan is applicable to all cases.

From what has been presented under the head of treatment, it will be seen that, while there is no specific for the affection, and only comparatively few cases are permanently benefited, much can be done to make life comfortable, and each case should be carefully studied with a view to ascertaining which plan is likely to be the most beneficial. As several observers have remarked, the aim should be not so much to find out new remedies as more accurately to determine the proper indications for those already possessed, and particularly the safe limits of the more radical surgical procedures.

¹ New York Med. Record, May 29, 1897, p. 767.

CHAPTER XVI.

SYPHILIS AND LUPUS OF THE LARYNX.

SYPHILIS OF THE LARYNX.

UNDER this heading are placed congenital manifestations and the primary, secondary, and tertiary varieties of the acquired form.

The manifestations of hereditary specific taint in the earliest years of life have been studied by numerous writers, among whom J. N. Mackenzie and Arslan may be specially mentioned. Arslan,¹ whose views may be taken as representative of those of Continental clinicians, does not believe the condition as common as does Mackenzie, who records seventy-six cases, fifty-three of which occurred under one year of age. Some of the sudden attacks of œdema and other suffocative seizures of early childhood may have as their foundation a syphilitic taint the existence of which is not suspected, and, as no autopsy is made, the true nature of the malady is never known. Mackenzie² says that "laryngeal lesions have not been found more frequently simply because they have not been sought. Laryngeal disease is not rare in congenital syphilis; it is one of the most constant and characteristic of the pathological phenomena, and we may look for an invasion of the larynx with as much confidence in the congenital as in the acquired form of the disease." The symptoms in such children may take the form of a general wasting and cachexia, together with such local manifestations as a husky voice, difficult swallowing, short cough, labored breathing, etc., with frequent attacks of laryngismus stridulus. Prognosis improves with the age of the child. The diagnosis is often difficult, though one may be aided by examination of the body for the ordinary stigmata of the syphilitic diathesis. The therapeutic test may alone confirm the diagnosis.

Treatment calls for the prompt administration of mercurials. Medication of the infant through the uncertain channel of the breast-milk is no longer followed. One may use ten grains of the official unguentum hydrargyri rubbed up with an equal quantity of white vaseline under the same general precautions which govern inunction methods in general, or one may give four times daily to an infant of one year, gray powder, one grain, or mercuric bichloride, one-sixtieth grain, or, if haste is required in bringing the system under the effect of the remedy, calomel, one-tenth grain. If any of the lesions can be discovered which in the adult are classed as tertiary (in which case there will probably be found

¹ Arch. Internat. de Lar., 1897, vol. x. p. 383.

² Am. Jour. Med. Sci., October, 1880, p. 321.

PLATE XI.

Syphilis of the larynx, especially of the vocal bands. (J. Schnitzler.)

Figs. 1 to 4 show the early forms of syphilis of the larynx. The conditions represented in these four figures date from the fourth, the sixth, and the eighth week after infection.

Fig. 1, redness and swelling of the vocal bands; the left vocal band shows on its edge a dark red spot which is sharply defined by a grayish-white line.

Figs. 2, 3, and 4 show the varied forms of syphilitic papules on the vocal bands. These small, gray-white, mostly round or oval infiltrations are characteristic of syphilis.

Figs. 5 and 6, appearances of the larynx several months after infection. Irregular ulcers on the vocal bands characteristic of syphilis of the larynx.

Fig. 7, comparatively circumscribed, but deep, syphilitic ulceration on the right vocal band in process of healing.

Fig. 8, complete destruction of the left vocal band, the vocal process alone intact. On the left ventricular band distinct cicatrization.

PLATE XI.

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mistaken for anything else. The mucous patch may be found on the vocal cords and, according to some writers, on the areas mentioned as the possible seats of erythema. It is one of the rare laryngeal lesions of specific disease. Erosions of various depths occur, the superficial being, as with the process in the pharynx, the result of the breaking down of either the mucous patch (page 505) or a superficial gummatous infiltration. The mucous patch suggests a search for skin lesions, generally of the papulo-squamous variety. Sometimes they take the form of condylomata, which are probably nothing but aggravated mucous patches. Occasionally in the secondary stage distinct tubercles form, breaking down later into cup-shaped ulcers with thickened edges. The details of these processes have been spoken of under the heading of syphilis of the pharynx. The shape of these superficial ulcers is rounded or oval, and they secrete pus of normal appearance. Under manipulation they easily bleed, but do not have the angry zone of an inflammatory process.

The most important lesion of laryngeal syphilis, in the sense of frequent occurrence and of potentiality for harm, is the gummy tumor, which, as a rule, does not appear until some six or eight years after the initial lesion, during which time the larynx may have given no symptoms whatever. The gummatous deposit may be diffused or circumscribed. In contrast to the lesions above noted, it affects the deeper layers of the mucosa and the cartilaginous structures. More generally when the cases come under observation the infiltration has become ulcerated; this early breaking down is due to the facts that the larynx is never at complete rest and that the irritation thereby caused to the mass leads to its early destruction. Occasionally tumor-like masses are seen, and it may be necessary to make a diagnosis between them and malignant disease. The obvious indication is always to give potassium iodide tentatively in cases of intralaryngeal growth, but to bear in mind the fact that potassium iodide will sometimes cause the subsidence of the inflammatory infiltration which forms a zone around a true malignant process. A hopeful prognosis cannot, therefore, be given from the immediate happy effects of the remedy. Inunctions of mercury may also be necessary. Bosworth quotes an Italian observer named Luca who saw a gummy tumor which had been attached to the posterior wall of the larynx for twenty-six months without change, yet it finally disappeared under antisyphilitic treatment. The symptoms of a gummy tumor will depend on its site and size, and consist of discomfort, though not much actual pain, some difficulty in swallowing, especially when the invasion is at the posterior part of the larynx and affects the œsophagus, and possibly dyspnoea. The sudden appearance of these masses and their stationary size, unless they decrease by ulceration, are points of value in diagnosis. The result of an untreated gumma, and sometimes in spite of treatment, is the formation of a deep tertiary ulcer. This develops from one or more sites over the infiltrated areas and burrows deeply down to the cartilages. The epiglottis is most

frequently attacked, and may be partially eroded or even completely destroyed. The true cords are next attacked, then the false cords and the posterior commissure. If the process extends to the cartilages, a perichondritis and chondritis are set up, with their own symptoms added.

Diagnosis must be made between this and tuberculosis, lupus, and malignant disease. The diagnostic points of value have been partly suggested in previous chapters. The syphilitic ulcer is excavated, covered with a grayish secretion, surrounded by an angry red zone, has sharp, well-defined edges, and, if it has progressed to any great extent, will appear in the midst of more or less necrotic tissue. Notwithstanding these definite characteristics, the diagnosis between tubercular and specific ulcers is, in the absence of collateral evidence, impossible from mere inspection, and one must call to one's aid the results of examination of matters expectorated and the effect of giving the iodides. The question is still further complicated by the possibility of a coexistence of tubercle and syphilis. These cases of dual infection are rare. According to Fasano, syphilitic disease in the larynx may change into tubercular. He explains this change on the assumption that, both maladies being of a bacterial nature, the micro-organisms of one disease may prevail over those of the other and gradually destroy them. How and when this change takes place is a matter of doubt, as the evidence is only clinical. Therefore, Fasano believes that the question is not one of symbiosis,—that is, the coexistence of the two maladies,—but of transformation of one to the other through the action of the tubercle bacillus through the lymphatics. It is generally agreed that in cases of dual infection the treatment of the specific element should be begun first. Damieno¹ believes that it is impossible, in the absence of the bacillus of Koch, to distinguish between the two. The exact local conditions greatly change with the death of the tissue and vary according to the methods of demonstration. In the syphilitic tissue he finds a more ready tendency to ulceration and fewer giant cells. Both lesions are to be regarded as granulomata. "As bacteriology gives us examples of micro-organisms which exist well together, so it also shows instances of antagonism which reaches such a point that one germ destroys the other. A similar condition should occur when a tubercular lesion is superposed upon a syphilitic one."

E. Lang² says that syphilis may by its manifold histological changes, perhaps also by the action of the toxin derived from the specific contagium, cause such essential alterations that the entire body is thereby weakened and more readily attacked by other partly functional, partly organic affections. Long-standing syphilitic skin lesions finally assume a lupoid appearance, and in such cases the actual presence of tubercle

¹ Cf. Jour. Laryngol., 1894, vol. viii. p. 384.

² Twentieth Century Med., vol. xviii. p. 280.

PLATE XII.

Gummata and profound destruction of tissue in consequence of breaking down of infiltration. Late stages of syphilis, mostly several years after infection. (J. Schnitzler.)

Fig. 1, characteristic irregular ulcers on the edges of both vocal cords; in addition a round, almost typical, ulcer on the left arytenoid cartilage.

Fig. 2, irregular ulcer on the laryngeal surface of the epiglottis, left side, with beginning ulceration on the left vocal band and left arytenoid cartilage.

Fig. 3, ulcer on the left ventricular band, with lardaceous, purulent covering.

Fig. 4, intense swelling of the epiglottis; the latter is unrecognizable by reason of diffuse infiltration. Entrance to the cavity of the larynx entirely occluded. On the left half of the epiglottis a deep, irregular ulcer with lardaceous covering; a second crater-like ulcer on the outer surface of the right arytenoid cartilage extending to the aryepiglottic fold.

Fig. 5, advanced syphilis of the larynx. Characteristic ulcers following breaking down of gummous infiltration on the edges of the epiglottis and on the outer surface of the arytenoid cartilage. Dirty gray, deep ulcers with lardaceous covering and circumscribed by sharply defined edges.

Fig. 6, the same larynx after several weeks of antisyphilitic treatment. Cure of ulcers, with great loss of tissue. Characteristic cicatrices.

Fig. 7, extensive and deep destruction of the larynx, especially of the epiglottis and arytenoid cartilage.

Fig. 8, same case, healed by systematic antisyphilitic treatment.

PLATE XII.

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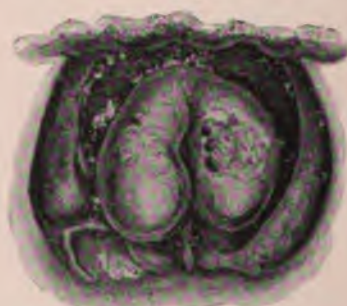
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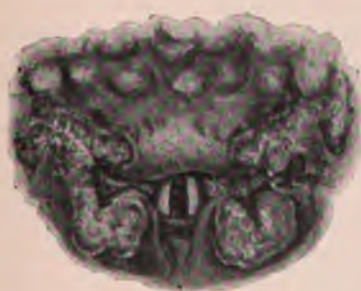
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bacilli has been demonstrated by Sasakawa. If this happens in the skin, it is a justifiable assumption that like changes may occasionally take place in neighboring organs. The deep ulcer is not in itself immediately dangerous; it may exist for years without special annoyance, though Ludwig Türck¹ has reported one case of fatal hemorrhage under these circumstances, the ulcer being situated on the vocal cord. Occasionally glottic spasm or sudden oedema may supervene and the patient succumb unless the facilities for an immediate tracheotomy are at hand. The final stage is that of cicatricial contraction varying in extent and location, and causing interference with phonation and respiration. Small ulcers, even if deep, may leave no trace behind them, though, if they be on the true cords, very small cicatrices may interfere with perfect intonation. The loss of the epiglottis does not especially interfere with deglutition, for the patients learn to so contract the muscles of the larynx as to cause its closure during swallowing. Adhesions of the epiglottis to the surrounding structures are very frequently observed, the epiglottic ligaments and the arytenoid cartilages being the sites of attachment. Rischawy² reports a case of complete adhesion of the epiglottis to the root of the tongue without any loss of substance, but here there was no interference with swallowing. In the interior of the larynx are frequently found cicatricial bands reaching from one point to another. A most unfortunate phase of this process is that in which ulcerations occur on symmetrical areas of the vocal cords, for then adhesions and a narrowing of the air aperture are likely to take place. The adhesion is generally at the anterior commissure and progresses backward, finally leaving (between the cords) a posterior irregular opening with curved edges. One cannot estimate the probable severity of symptoms from the size of the opening left; small openings may present no dyspnoea, while it may be present in large ones. In such cases there is special danger of oedema of the glottis or of glottic spasm. Patients liable to attacks of dyspnoea, however slight, ought to be in a hospital, for the attacks may come on at any time, requiring immediate surgical intervention. Another dangerous condition is found in ulcerations simultaneously occurring on the rim of the epiglottis and the surrounding pharyngeal walls, for the entrance of the larynx may become blocked, causing serious dysphagia and dyspnoea. All forms of laryngeal distortion may be seen, and even when the larynx itself is free, similar lesions may be present in the subglottic region or in the trachea, manifesting the same symptoms and calling for the same treatment. At times it may be difficult, from mere objective appearances, to distinguish between cicatricial contraction due to specific disease and that due to lupus. The latter disease, however, does not present ulcerations as does syphilis, and the amount of cicatricial tissue is much less.

¹ Klin. der Krankh. d. Kehlkopfs, Wien, 1866, S. 413.

² Wien. Klin. Rundsch., 1899, No. 28, S. 453.

Treatment.—The treatment of laryngeal syphilis is similar to that indicated for the malady in general. Erythema usually disappears promptly under the mixed treatment, and local irritation can be allayed by the measures employed in simple acute laryngeal catarrh. The same may be said of the mucous patch. Ulcerations, if superficial, should be sprayed with a weak cleansing solution, and then a powder, such as iodoform, iodol, etc., insufflated. It may be said that, in spite of the many substitutes which have been proposed for iodoform, it easily maintains its supremacy for the purpose indicated. The deep ulcer and gumma require the systematic use of the iodides in increasing doses, which may after a while be gradually decreased and then increased again. In this way the same results seem to be secured with a minimum likelihood of any annoying disturbance of bodily function. For the relief of cicatricial stenosis many forms of dilating and cutting instruments have been devised; the large intubation-tube here finds a valuable field of application. The possibility of œdema from the iodides must not be forgotten. All these cases must be watched, for no matter how brilliant the immediate results of treatment may appear, there is always danger of relapse.

LUPUS OF THE LARYNX.

The common opinion concerning the relations of lupus and tuberculosis has been mentioned when speaking of lupus of the pharynx. Lupus of the larynx is comparatively a rare disease. As a rule, it is a later localization of the skin lesions of the same disease, but cases are recorded in which the laryngeal has preceded the cutaneous affection. A fair estimate would be that from eight to ten per cent. of all cases of skin lupus show, sooner or later, evidences of laryngeal invasion, which may occur without any manifestation in the intervening faucial regions.

Etiology and Pathology.—Lupus in general appears to be one of the manifestations of the scrofulous diathesis. Its general characteristics have been mentioned in the chapter alluded to, and need not be repeated here. Of the laryngeal cartilages the epiglottis is the one most often attacked, though the arytenoid may share in the process, in which is found the same formation of nodules, ulcerations, and contraction. The ventricular bands and aryepiglottic folds are perhaps the favorite seats of the process in the soft parts.

Symptoms.—From the very slow development of the disease the symptoms in the larynx may for a long time hardly be noticed. These cases more often come under the dermatologist's care. Finally, a husky voice leads to a laryngeal examination, and the site of involvement of the larynx is discovered. The vocal impairment presents no peculiar features, but simply varies in degree according to the affection of the true cords or the ventricular bands and posterior commissure. Pain in swallowing, if present at all, is but slight. If the deposits in the larynx be so situ-

ated as to encroach immediately upon the breathing space, dyspnoea is experienced, which is perhaps the most serious feature of the disease. The inflammation and œdema which accompany so many other intralaryngeal processes are here wanting. As a rule, wasting of tissue takes place rather than swelling and consequent dyspnoea.

Prognosis and Diagnosis.—Except in those cases attended by laryngeal stenosis, the disease is not especially fatal, though it may continue indefinitely. Fortunately, it would seem that if the stenosis occurs at all, it comes on early in the course of the malady. The diagnosis has to be made between this malady and tuberculosis, syphilis, and, at times, malignant tumors. In tuberculosis the disease is more apt to attack patients about middle life, while lupus is found in the earlier decades. There is no constitutional disturbance in lupus, no lung lesion; pain is wanting or, if present, only slight, and usually there are found skin lesions which at once suggest the nature of the disease. The interior of the nose should always be looked at in these cases, and the long continuance of the case will also be of assistance in forming an opinion. Syphilis presents its own history, is, as a rule, without pain, and at the period when it may have to be distinguished from lupus exhibits no constitutional symptoms. The therapeutic test will also help in diagnosis, as mercury and the iodides seem to render lupus distinctly worse. It is perhaps in the pharynx and palate that the distinction between these two affections is the more difficult. In malignant tumors the age of the patient, marked pain, rapid course, cachexia, etc., will generally suffice to make a diagnosis.

Treatment.—The same general tonic course should be followed as for the lesion in the pharynx; so also with the local measures. The effect of the X-rays as a therapeutic agent here suggests possibilities which may prove to be of some definite value in radical cure. In the cases attended by stenosis the question of tracheotomy comes up. Fortunately, the slow course of the disease gives ample time to fully consider the applicability of the procedure to each case.

CHAPTER XVII.

TUMORS OF THE LARYNX.

BENIGN TUMORS OF THE LARYNX.

THE laryngologists of to-day see fewer laryngeal growths than did their predecessors. Moreover, American practitioners do not appear to observe as many cases as do their English colleagues, nor the latter as many as the Continental clinicians. J. Wright has suggested that possibly the prompt attention given in America to affections of the nasal cavities may have some relation to the comparatively small number of laryngeal growths. The older civilization in the European countries may also be a factor in the result.

Etiology.—In the great majority of cases no definite cause can be assigned for such growths. Some seem referable to vocal strain, others follow eruptive fevers, exposure to cold, and irritant inhalations, but a previous catarrhal condition is not found with any regularity, and a few cases of congenital tumor-growth are on record.

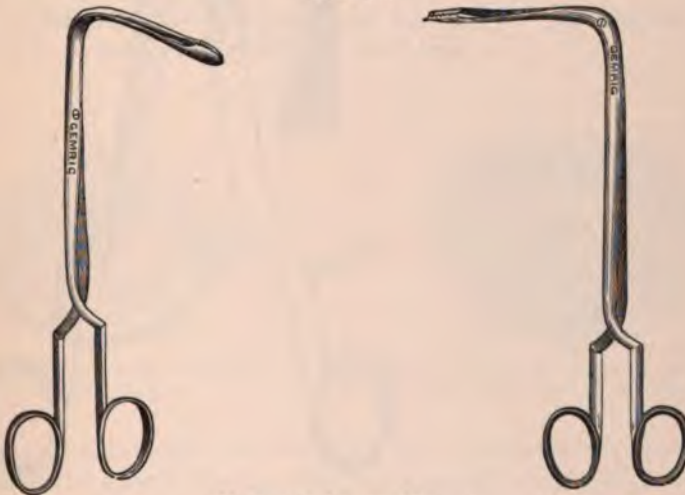
Symptoms.—These consist of interference with phonation and, in the more marked cases, of disturbance in respiration. If the growth be situated at some site other than the vocal cords, such as the aryepiglottic folds, epiglottis, or ventricular bands, and so lies that the approximation of the cords is not interfered with, it may reach a surprisingly large size before attention is drawn to the condition. A pedicled growth may, from its varying position, sometimes give rise to symptoms and again to none. Supraglottic neoplasms often cause cough, but pain is rare. Spontaneous bleeding is rare, though blood may escape as the result of attrition, but free bleeding suggests malignancy. Respiration may be so gradually interfered with that no special difficulty is experienced until a severe cold develops an additional impediment from swelling of the mucosa. Glottic spasm is not unusual, while dyspnea is more common in connection with infraglottic masses.

Prognosis.—Unless the tumor attains such a size as to obstruct the breathing passage, or, being pedicled, falls into the glottis and sets up a spasm, the prognosis, so far as danger to life is concerned, is in a general way good. Except with papilloma, the growths do not, as a rule, recur after complete removal. Prognosis as to entire restoration of the voice after removal is generally good.

Treatment.—In cases of urgent dyspnea, intubation or tracheotomy may be necessary. As a rule, the treatment resolves itself into removal by cutting instruments or by destruction of the mass *in situ*. The former requires various forceps, of which there are many varieties, snares, and

guillotines. In many cases the snap-guillotine serves admirably. Forceps are sometimes used to crush the growth, with a view to its subsequent disappearance by absorption. Small sessile growths may be destroyed by either chromic acid or the galvano-cautery. Lennox Browne regards the use of chromic acid as attended by risk out of all proportion to any possible chance of benefit, while as to the galvano-cautery he reiterates his statement of twenty years ago, that it is a dangerous instrument to use below the level of the epiglottis. It is evident that the shape, size, and location of the growth will determine the choice of the means of removal. Ordinarily, in adults at least, these operations are performed under local anæsthesia. In children general anæsthesia is neces-

FIG. 260.



Mackenzie's laryngeal forceps.

sary, and Scanes Spicer strongly recommends chloroform, with the local employment of cocaine to control excess of secretion.

Semon's well-known collective investigations have shown that the probability of the transformation of benign into malignant growths is extremely remote. In some instances there has been a spontaneous expulsion of the tumor.

The following varieties of benign growths, given in order of relative frequency, are found in the larynx: papilloma, fibroma, cystoma, myxoma, lipoma, angioma, adenoma, enchondroma, lymphoma, and colloid growths. Papillomata are more common than all other forms combined. They occur by preference on the anterior third of the true cords, less often on the aryepiglottic folds, ventricular bands, and epiglottis, the right side being oftener affected than the left. The tumors may be single or multiple, sessile or pedicled, smooth or with a cauliflower-like surface.

The size varies from that of a pin-head to that of a mass entirely filling the cavity of the larynx. The condition is one of epithelial proliferation,

FIG. 261.



Dundas Grant's guarded forceps.

the cells piling themselves up on the surface and producing a wart-like growth. Papillomata are more common in children and young adults.

FIG. 262.



Mathieu's laryngeal snap-guillotine.

Occurring in a person past middle life, they should always excite suspicion, for, no matter how innocent they appear, they may be the initial

stage of a malignant growth, and persons thus affected should be examined at regular intervals. Removal is generally easy, but thorough eradication sometimes very difficult. Some of these growths have seemed to disappear under frequent spraying with absolute alcohol. In young children a tracheotomy will sometimes lead to their disappearance by putting the glottis completely at rest, but recurrence may take place after the tube is removed. In other cases it is necessary to perform thyrotomy and thoroughly eradicate the masses.

Fibromata occur next in frequency and belong to a later period of life. Their structure is essentially the same as that of fibromata elsewhere,—*i.e.*, one of interlacing connective-tissue fibres containing branching cells, with a scanty blood-supply and a hyperæmic mucosa. They are usually sessile, and located on the anterior portion of the cords. Many of the reported fibromata are thought by pathologists to be analogous in structure to œdematous nasal polypi.

FIG. 263.



Papilloma of the cord as usually seen.
(Lennox Browne.)

FIG. 264.



Papilloma covering the laryngeal aperture and
attached anteriorly. (Grünwald.)

Cystomata originate from occlusion of a gland-duct or from cystic degeneration of a gland-lobule. They occur on the epiglottis, true cords, or in the laryngeal ventricles. When on the cords they appear as translucent masses, but when located higher up they are more opaque. They belong to the middle period of life, and when once removed rarely return. The contents are generally of a mucoid nature. Tervaert¹ collected the records of ten cases in which the sacs seemed to contain air. Such cases have been regarded as congenital enlargements of the sacculus laryngis.

Myxomata are often confounded with œdematous fibromata. They occur invariably on the cords, may be either sessile or pedicled, and in general appearance may resemble either ordinary myxomata, as seen in other parts of the air-tract, or papillomata.

Lipomata are rare. They are regularly attached to the aryepiglottic fold, falling thence into the hyoid fossa, where they may expand into a considerable size. Both the galvano-cautery and scissors have been used for their removal.

¹ Ann. des Mal. de l'Oreille, 1898, vol. xxiv. p. 572.

Angiomata are also rare. They arise by preference from the vocal cord, but have been found on the ventricular bands, epiglottis, and in the hyoid fossa. They appear as muriform masses, and are made up of a vascular mesh-work held together by connective tissue.

Adenomata are naturally more common in those localities in which glandular supply is abundant, such as the epiglottis and sacculus laryngis. Lennox Browne believes that all such growths should be regarded with grave suspicion, adding that "the term adenoma may be a mere euphemism for quiet cancer." Some deny that true adenoma ever occurs here.

Enchondromata arise from one of the laryngeal cartilages, preferably the cricoid, and are made up of hyaline substance; though, if springing from the epiglottis, there may be an admixture of fibrous tissue. They are usually sessile, of irregular outline, and may become eroded.

Lymphomata and colloid growths are mentioned but rarely in the literature of laryngeal tumors, and would probably not be recognized as such from their gross appearance.

EVERSION OF THE LARYNGEAL VENTRICLE.—A condition occasionally seen in the larynx may here be mentioned,—viz., eversion or prolapse of the laryngeal ventricle. Though appearing as a tumor, it is in no sense a neoplasm, and is mentioned under this heading only as a matter of convenience.

The anatomy of the ventricle has already been mentioned (p. 583). Occasionally there is found protruding from its site a fleshy mass looking very much like a fibroma, but devoid of the latter's firmness. It overhangs the true cord and shows some of the symptoms of a true tumor. It was formerly supposed to be an actual prolapse of the ventricular lining, but more recently it is looked upon as the result of rapid swelling or of the entanglement of foreign material in the ventricle itself (Shurly). Some cases seem to result from injury. Careful probing will usually distinguish it from a fibroma, the only kind of growth with which it is liable to be confounded. The symptoms are usually of a mild type, being those due to interference with respiration and phonation. Treatment consists in removal with forceps or snare, though in some instances it may be necessary to split the thyroid cartilage and thus gain freer access to the deformity.

MALIGNANT TUMORS OF THE LARYNX.

SARCOMA.—The relative infrequency of sarcoma in this situation may be learned from the figures of Gurlt, quoted by Bosworth. Out of eight hundred and forty-eight cases of sarcoma seen in two of the Vienna hospitals there was but one of sarcoma of the larynx. During the same period sixty-two cases of laryngeal carcinoma had been noted out of a total of nine thousand five hundred and fifty-four instances of cancers

affections in general. Laryngeal sarcoma occurs three times as frequently in men as in women, and affects middle and later life. Statistics show that it develops in women at an earlier age than in men. As to its special cause, nothing is known. Various histological varieties are found,—spindle- and round-celled, alveolar and giant-celled,—the names being given in order of relative frequency in recorded cases. Most of such growths are located on the true cords, though any part of the larynx may be affected. All authors note the fact that if the larynx is primarily attacked, the tumor seems to confine itself thereto. It does not extend to the pharynx, extension in the opposite direction being the rule. Ulceration occurs later, but erosion of cartilage is rare.

Symptoms.—The first symptom attracting attention is generally vocal impairment, gradually progressing. As the mass encroaches on the air-tract, respiration becomes impeded, and cough is generally present, though not, as a rule, annoying. Pain is not often felt, though if the epiglottis or parts above be involved there is more or less painful swallowing. The cervical glands have been affected in about one-seventh of all recorded cases, more commonly with the round-celled and alveolar forms of the disease.

Duration.—The duration of a given case cannot be predicted. Some patients come under observation after complaining only a few weeks, while others have suffered as many years. The round-celled and alveolar forms grow most rapidly.

Diagnosis.—Without the aid of the microscope it is impossible positively to decide in laryngeal growths between sarcoma and carcinoma. Ulceration comes later in sarcoma, pain is less, while growth is, as a rule, more rapid. Projections from the central mass are more apt to be broad and rounded.

Prognosis.—This is always bad, though collected figures seem to show that the outlook for prolongation of life is somewhat more favorable in sarcoma than in carcinoma.

Treatment.—This is purely surgical, and will be considered under the heading of treatment of carcinoma. No good results have thus far been obtained in sarcoma of the larynx from the use of erysipelas toxins.

CARCINOMA.—Under the heading of carcinoma of the larynx reference is made to those cancers which affect this organ primarily and not to those which invade it from surrounding areas. In regard to the frequency of malignant disease in this organ, the most accurate ideas are based on the figures collected some years ago by Sir Felix Semon,¹ when unusual interest in this disease was aroused by the illness of the Emperor Frederick. From one hundred and seven reporters, statistics of ten thousand seven hundred and forty-seven cases of benign and fifteen hundred cases of malignant growths of the larynx were carefully col-

¹ Centralbl. f. Lar., 1889, passim.

lected. Carcinoma occurs from three to four times as often in men as in women. The general principle of heredity as applied to cancer is equally pertinent here. Cases have been reported in very young children, but most occur from the fortieth to the seventieth year. The better classes suffer more than the poor. Many of the patients have been voice-users, but nothing definite can be stated as to the cause of this special localization.

The most common form of laryngeal cancer is epithelioma, which here presents no special histological features; other varieties which have been reported from time to time are combinations with adenoma, scirrhous (rare), and the encephaloid form. The mixed form with adenoma appears to grow more slowly than the others, and in so far is more favorable for operation. Various parts of the larynx may be affected, the left side seeming to be the more common starting-point of the growth, that appears by preference on the ventricular bands. Other starting-points are the

true cords, epiglottis, commissures, and aryepiglottic folds. As long as the growth confines itself to the laryngeal cavity, the cervical glands are not involved. This sparing of the cervical lymph-nodes is due to the peculiar arrangement of the lymphatics, not to their scarcity in the interior of the larynx. Even in intrinsic cancer the glands at the sides of the trachea and bronchi are often invaded. Thiriet¹ says that the gland most frequently involved in extrinsic cancer is the one at the level

FIG. 265.



Carcinoma of the larynx. (Grünwald.)
a, ulceration.

of the anterior border of the sternomastoid muscle at the height of the space separating the hyoid bone from the thyroid cartilage.

Symptoms.—The first symptom is a huskiness of the voice, which goes on to actual hoarseness, weakness, and aphonia. Meanwhile, cough and dyspnoea may be added. At first pain appears only on swallowing, later intermittently, independent of this function, and finally is constant. It is, unfortunately, worse at night, so that the patient is robbed of his sleep. Appetite fails, emaciation comes on, and finally the characteristic cancerous cachexia, though the latter is comparatively late and is often absent. The relative order of symptoms is largely determined by the site of the tumor. Some authors mention salivation as a constant feature. Later stages are characterized by ulceration and possibly hemorrhage. The ulceration is due either to increased cell-proliferation or to attrition of affected surfaces, and is accompanied by a foul discharge of mucus and muco-pus mixed with cell detritus and necrotic tissue. A peculiar odor

¹ Thèse de Paris, 1889.

often accompanies this discharge, as in cancer of the pharynx. Finally, in the very last stages, the growth may penetrate the laryngeal cartilages and appear in the neck as a fungoid mass. Cartilaginous sequestra may be extruded, while pieces of the tumor may be coughed up or, becoming loose, fall back into the air-passages. Before this stage is reached, tracheotomy may have become necessary to prevent suffocation by direct encroachment. Cough is incessant, swallowing almost if not quite impossible, and the general condition one of the most abject misery. Death occurs from exhaustion, inspiration-pneumonia, suffocation, or rarely from hemorrhage due to the erosion of a large vessel.

Duration.—Three years is practically the limit of life, dating from the first appearance of the disease, except in the adeno-carcinomatous cases, which are of slower growth, and may continue a year or two longer.

Diagnosis.—In view of the terrible nature of the malady and the advisability of early operation, recognition of the exact nature of a laryngeal tumor becomes a matter of the most urgent importance. J. N. Mackenzie¹ says that there are "three principal methods of diagnosis in laryngeal cancer. These are in the order of their practical importance and usefulness: (1) the naked-eye method, or diagnosis by direct inspection supplemented by clinical phenomena; (2) thyrotomy; and finally (3) the microscope. Of the three methods, the second is often included in, and therefore ancillary to, the first."

This author thinks that surgeons have in recent years relied too much on the microscope alone, or rather that in their devotion to it they have neglected other and valuable means of diagnosis. Nothing would appear more natural than that one should remove a piece of the tumor for examination and on the findings of the latter base his subsequent action, and this is undoubtedly the course most often followed. The objections to this procedure are (Mackenzie) that it subjects the patient to the dangers of autoinfection at the point of incision and to metastasis at other sites, stimulates the local growth of the malignant mass, and is often inconclusive and misleading and at times impossible. The removal of a fragment of the tumor for examination is strongly condemned by many writers, unless the patient's consent to immediately undergo radical treatment, provided the findings demonstrate malignancy, be previously obtained. Malignant tumors here, as elsewhere, do not grow with a regular rate of increase. After a period of quiescence they may suddenly start up into renewed activity without apparent cause, and grow so much more rapidly that, if the removal of tissue happens to coincide in time with one of these periods of recrudescence, the former is given the credit of having caused the latter. This is one of the arguments used to justify the position of those who counsel removal of tissue for examination. As

¹ New York Med. Jour., September 8, 1900, p. 397.

bearing on this point there may be cited the statement of O. Chiari,¹ whose personal experience was that out of twenty-eight incisions for removal of tissue, rapid increase of growth was noted only once. In this case, which was one of epithelioma on the free edge of the cord, increase of growth was noted in five days. Of the danger of autoinfection, however, there can be no question.

As to differential diagnosis, it may be said that some epitheliomata resemble papillomata in gross appearance. Moreover, as is well known, bits of tissue removed for examination may be superficial and not histologically representative of the whole growth, so that an opinion predicated on these superficial portions alone is necessarily erroneous and incomplete. Jurasz notes that malignant tumors appear to grow into rather than out of the underlying tissue. A snow-white color of the growth has been considered evidence of malignancy. In the Transactions of one of the meetings of the Laryngological Society of London, Semon² is quoted as having said, "that if one met with a growth of particularly snow-white color which at first sight looked like a papilloma, but the eminences of which were not nearly so bulbous and rounded as in papilloma, but *sharply pointed* like grasses, that such an appearance was extremely suggestive of malignant disease."

Age is of some value in diagnosis. Thus, below thirty years the mass is probably not carcinomatous, but after fifty it is probably malignant, especially if occurring in a larynx free from previous disease. Pedicled growths are more likely to be benign, and all the more so if, after an existence of several months, there be no evidence of surrounding inflammation or infiltration. Hindrance to free movements of the cords is to be looked on as suspicious, and the same remark applies in adults to recurrence after removal. In this disease there may also be flat ulcers with sharply cut edges.

Roquer Casadeus³ lays down the following general propositions as a guide to diagnosis. (1) In patients of forty years and over all hyperplastic masses on the posterior third of the cords, whether pedicled or not, of firm consistency if nodular, if bleeding easily, of crescent shape, and accompanied by a certain degree of immobility of the parts, lead to a strong suspicion of cancer. (2) All vegetations springing from the epiglottis or margins of the larynx, of a rosy color, bleeding easily, with a slight infiltration of neighboring parts, should lead (if one can exclude syphilis) to a suspicion of cancer. (3) If a piece of the growth be removed for examination, it must include not only the whole thickness of the tumor, but also some of the surrounding healthy tissue.

¹ Arch. f. Lar., Bd. viii. S. 84.

² Jour. of Laryngol., February, 1900, p. 77.

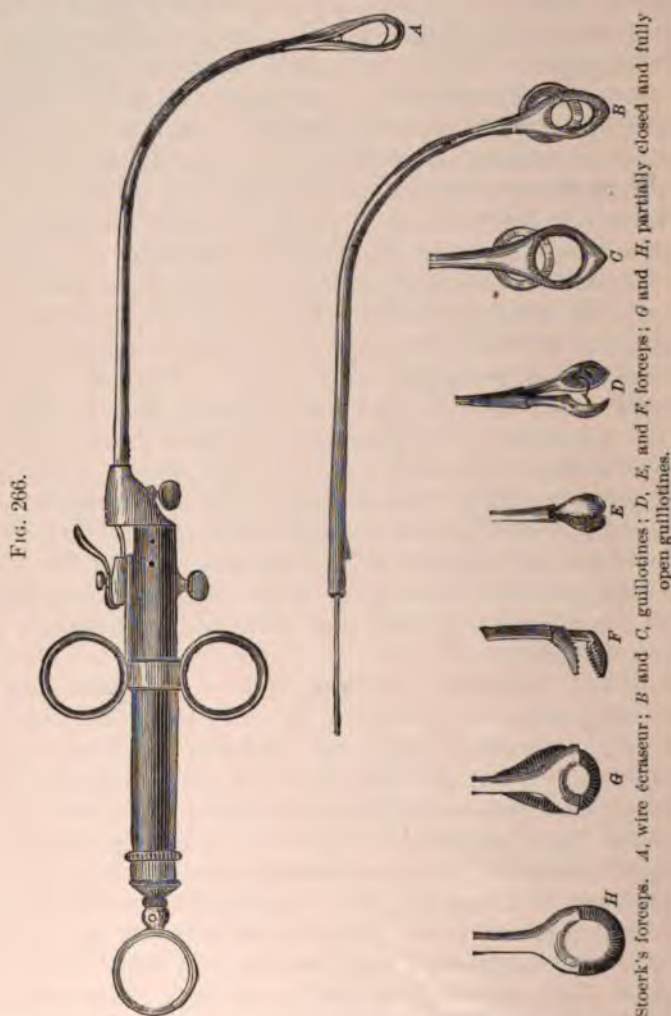
³ Ann. des Mal. de l'Oreille, 1900, vol. xxvi. p. 160.

The foregoing represent fairly well present views on this difficult matter of differential diagnosis.

When adults present themselves with more or less infiltration surrounding a central focus in the larynx, the question at once comes up as to differentiation between tuberculosis, syphilis, and malignant disease. As regards the former, there are, as has been seen, certain slow forms of laryngeal involvement quite different in appearance from typical tubercular laryngitis. Under such circumstances one must carefully look for evidences of tuberculosis elsewhere, watch the temperature, examine any sputa which may be available, and take evidence from a wide field before forming an opinion. In syphilis the body must be carefully examined for stigmata of the disease, due attention paid to the previous history, and the patient given the benefit of the therapeutic test of the iodides. Here one must guard against the fallacy of diminution in the mass, for while it cannot be asserted that potassium iodide causes a diminution in the actual cancerous mass, it does often bring about a temporary reduction of the inflammatory zone surrounding the cancerous focus, in a gross sense being part of the tumor. The reduction in size is but temporary, and must be given, as evidence, only its due weight. Finally, the possibility of symbiosis of malignant growth with either syphilis or tuberculosis must always be remembered. The foregoing remarks apply particularly to those growths which start inside the larynx and present simply as rounded swellings or infiltrations, from which it is difficult to remove a fragment for examination. After the ulcerative stage has appeared there is found the usual fungating appearance, with swelling of the surrounding parts and more or less distortion and loss of the usual landmarks.

Prognosis and Treatment.—Nothing short of surgical intervention offers the least prospect of prolonging life, and the matter turns on the procedure to be followed in each case. Of late years the opinion has been steadily gaining ground that cancer of the larynx is a condition calling for operation from without rather than from within. Middlemas Hunt believes that "any one who attacks a malignant growth by the endolaryngeal method takes upon himself a grave responsibility, and must be possessed of a high degree of manipulative dexterity." Ablation of visible masses by means of forceps does not by any means imply removal of all the malignant deposit, which may have infiltrated to a much greater extent than appears on the surface. Of instruments employed for this purpose may be mentioned, in addition to the various forceps, etc., previously alluded to, the forceps of Stoerk with various distal shapes, and those of Schrötter. All of these have the disadvantage of being able to remove only small portions of the growth at each section, with all the disadvantages above mentioned as incident to this method. Surgeons are therefore obliged to resort to partial or entire thyrotomy or laryngectomy.

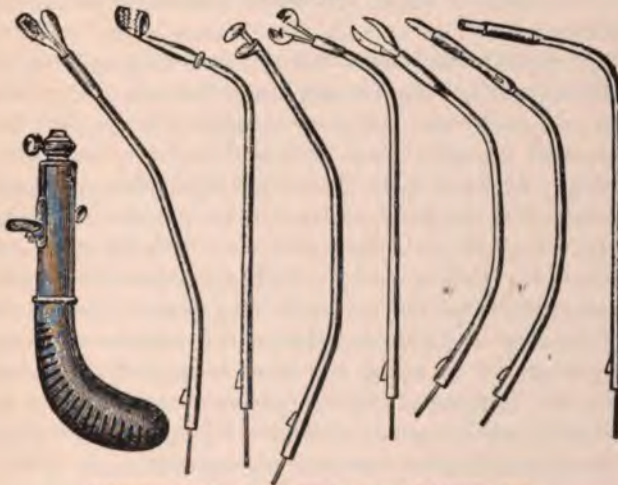
For the removal of malignant growths thyrotomy is most frequently indicated, and in order to be successful it must be undertaken very early. Not only must the growth itself be thoroughly eradicated, but an area of surrounding healthy tissue must also be taken out. Other conditions of success are limitation of the disease and its confinement



within the laryngeal cavity without involvement of the cervical lymph-nodes. The operation is not especially difficult. Even if the patient survive the three years' limit (the criterion of perfect success), there is great danger of permanent impairment of voice. Mackenzie takes a wider view of the applicability of the operation (for the details of which the reader must consult treatises on general surgery), declaring it justi-

fiable if the examination of the larynx leave one in doubt as to the exact nature of the conditions to be dealt with or fail to define the exact limitations of the disease. Enlargement of the cervical glands he declares to be no contraindication. Thyrotomy itself may fail to define, either by the direct view it affords of the parts or by the opportunity it gives for digital examination, the exact area affected. Parts seeming to the eye to be perfectly healthy may under the microscope show malignant invasion. His general conclusion is that cancer calls for total extirpation not only of the larynx but of the lymphatic structures and even adjacent cervical tissues. In other words, one should apply to this region the same surgical principles which in cancer of the breast and other organs have led to such brilliant successes.

FIG. 267.



Schrötter's tube forceps, with knives and applicator.

In presenting the question of operation to the patient the surgeon is asked to express an opinion on the probable outcome, and this can be based only on recorded experience, which it must be confessed does not offer a very favorable outlook. The statistics in this field are, unfortunately, incomplete and misleading, as unsuccessful cases have not been recorded. Moreover, in some which have been placed on record more than one operation has been performed, and perhaps reported as an additional case. Again, the line of demarcation has not been drawn between thyrotomy and partial laryngectomy; hence it is difficult to get an accurate idea as to the prospects of success.

Chiari,¹ in a statement of personal experience, notes that in the course of eleven years, from 1887 to 1898, eighty-three patients came under his

¹ Ann. des Mal. de l'Oreille, 1899, vol. xxv. p. 250.

observation in whom he felt justified in making a diagnosis of cancer. Operation was advised and accepted in twenty-five. Of this latter number eight died shortly after thyrotomy, nine of recurrence between six and eighty-six months after operation, and eight remained cured at periods ranging between one and five years, six of them having passed the three years' limit.

The latest statistics are those of D. Bryson Delavan.¹ They are too extensive to be quoted in full here. Suffice it to say that they show a gradual, though slight, improvement in cases of recent years over those of a former period. In total laryngectomy the recoveries (living over three years) amounted to six per cent., in partial extirpation to twelve and one-half per cent., and in thyrotomy to eighteen per cent. Total laryngectomies comprise thirty-four cases by six operators, partial laryngectomies fifty-six cases by eight operators, and thyrotomy fifty cases by seven operators.

From these statistics it is seen that the outlook is not especially favorable, though very recent figures are somewhat more encouraging than earlier ones. In each case the patient should have the matter fairly stated to him, and his permission obtained to have done whatever may seem necessary. Modern surgery has met with some brilliant successes in this direction, but the great advance is to come from a more thorough cultivation of the art of early diagnosis, on which the result of operation so closely depends. Removal of the larynx is a terrible mutilation: one or two forms of artificial larynx have been devised, but the wearing of them is tedious, and the patient speaks in a monotone, though capable of articulate speech. In a few instances some fold of tissue above the laryngeal site has by a remarkable provision of nature taken on the function of a vibrating medium, and articulate whispering speech has become possible without any larynx whatever, either natural or artificial.

It hardly seems necessary to add that the average laryngologist who may perform with skill all the usual intralaryngeal manipulations is not the one to undertake an excision of the larynx. The rights of the patient demand that an operation of such magnitude should be intrusted only to a general surgeon thoroughly skilled in all modern technique, preferably one who has had some experience in laryngological work, and who appreciates the difficulties of this special field of practice.

¹ New York Med. Jour., September 15, 1900, p. 449.

CHAPTER XVIII.

NEUROSES OF THE LARYNX.

NEUROSES of the larynx may be divided into (1) paralysis of sensation and (2) paralysis of motion. The causes in either case may be functional or organic.

PARALYSIS OF SENSATION.

Under this heading are to be considered anæsthesia, hyperæsthesia, paræsthesia, and conditions of neuralgia of the larynx.

Anæsthesia, or loss of sensation, is due to an impairment of function of the superior laryngeal nerve, either from alteration of structure at its origin, as in bulbar paralysis, or from various diffuse cerebral lesions, affections of the medulla, locomotor ataxia, or local neuritis from the poison of diphtheria. It occurs in minor degrees in long-continued catarrhal states, syphilis, and hysteria. It is evidenced then by the absence of cough and reflex; in the more severe forms there is danger of accumulation of secretion, food, etc., with consequent choking. The prognosis depends on the possibility of removing the cause. Diphtheritic and syphilitic cases generally recover under systemic treatment. General treatment consists in the administration of arsenic, strychnine, phosphorus, zinc, etc., together with the use of the faradic brush, applied daily; the latter should be introduced into the larynx six or eight times at each sitting. The other electrode may be placed over the larynx externally, or a large flat sponge may be put at the nape of the neck. In milder cases the placing of the electrodes one on each side of the larynx may suffice. In the worst cases feeding with the tube is necessary.

Hyperæsthesia depends partly on the natural irritability of the part, but more frequently it is directly due to some catarrhal state or is a reflex neurosis from a lesion higher up in the respiratory tract or pharynx. It is especially noticeable in laryngeal tuberculosis and in carcinoma. The rheumatic or gouty diathesis seems to predispose to it, and it may be symptomatic rather than an independent lesion. The condition is often so pronounced that swallowing or even speaking causes intolerable pain. Treatment obviously consists in removal of the cause. Neurotic cases require the usual sedatives, such as bromides, valerian, etc., while cases with gouty and rheumatic tendencies call respectively for colchicum and the salicylates. A careful search should be made throughout the entire upper air- and food-tracts for a possible lesion which may cause reflex irritation, and this should be done before any treatment is directed to the larynx itself. In incurable conditions, such as carcinoma and tubercu-

losis, the pains may be relieved by the means mentioned under those headings. Catarrhal conditions are relieved by sedative inhalations.

Paræsthesia refers to abnormal but not distinctly painful sensations in the larynx, of which there may be an infinite variety. The most common are a feeling as of a foreign body, tickling, desire to swallow, etc. Here again it should be said that the vast majority of these are referable to some condition in the parts above, the reflex irritation being referred to a lower level. Foreign bodies often lodge momentarily and then are expelled, leaving behind a sore spot, and thus giving the patient the feeling as if the foreign substance were still there. People of nervous temperament and low vitality, especially hysterical women, make up the majority of such sufferers. Treatment should commence with the reassurance of the patient, careful examination should be made to detect, if possible, the source of the trouble, sedative inhalations may be used with benefit, and the same general tonic measures followed as suggested in the preceding section.

Neuralgia of the larynx has been variously ascribed to gout, rheumatism, anæmia, malaria, ulcerative processes of various kinds (though rare in syphilis), and all acute inflammations. Sometimes no cause is apparent, but generally one can be found by patient searching, and each will suggest its own proper remedy. If no local condition need attention, one may have recourse to those agents which act so well in neuralgias elsewhere. Combinations of acetanilid, monobromate of camphor, caffeine, etc., are all applicable, and especially aconite or its alkaloid may be given in small and relatively frequent doses up to full physiological effect.

MOTOR NEUROSES.

Motor neuroses are divided into two classes,—(1) spasmodic and (2) paralytic.

LARYNGEAL SPASM.—Spasm of the glottis has already been considered in its most common aspects under the heading of local inflammation causing reflex irritability and in children croupy conditions. The matter is further mentioned in the chapter on foreign bodies in the air-tract. In addition to all these there is a condition of spasm purely neurotic in character, consisting in a closure of the glottis, coming on suddenly, and during its persistence shutting off more or less of the air-supply. At other times the latter may be normal, but there is a spasm of the muscles of phonation. Respiratory spasm presents certain differences in children from that in adults. It is, therefore, advisable to discuss the two conditions separately.

SPASM OF THE GLOTTIS IN CHILDREN.—In young children the laryngeal structures are all soft and yielding. Rachitis is found to be the main underlying condition in patients of this class, but bad hygienic surroundings, lack of proper food, and insufficient clothing all contribute

their influence. The exciting cause of an attack may be either local irritation, as from a bit of food in the larynx, prolonged crying, exposure to cold, pertussis, etc., or reflex irritation, especially from intestinal disturbances (indigestion, parasites). The teething period is a time of great susceptibility. Pressure on the trunks of the laryngeal nerves is in some instances a cause, while in others an overgrowth of the lymphoid tissue in the nasopharyngeal vault is the probable origin of the disease.

Occurrence.—This form of disease generally occurs during the first eighteen months of life, and is far more common among boys.

Pathology.—The condition is one of spasm of those muscles which close the glottis,—namely, the arytenoid, the lateral crico-arytenoids, and the thyro-arytenoids. A relatively similar result may arise in minor degree from the unopposed action of these same muscles owing to paralysis of their physiological antagonists, but this is not true spasm. As indicated under etiology, the spasmodic motor impulse may be a reflection of a sensory impulse from various areas or may originate in the nerve-centres from malnutrition. In either event it follows the fibres of the pneumogastric.

Symptoms.—The symptoms may show themselves without warning, and are more frequent at night. The child suddenly starts up, gasps for breath, and, if the attack be prolonged, speedily becomes cyanotic. There is the usual inspiratory stridor, and expiration may be attended by a sound indicating stenosis of the glottis. The duration of the spasm varies, rarely lasting, under ordinary circumstances, more than fifteen or twenty seconds. Then the muscles relax sufficiently to permit the entrance of enough air to sustain life, though the spasm may not entirely subside for some time. Death occurs frequently in the stage of apnoea. The attack may not be repeated until the next night, or it may come on at irregular intervals. In the worst cases the spasm involves the respiratory tract and appears in the hands, feet, and limbs. If the attack be often repeated, the child soon shows impairment of nutrition.

Diagnosis.—The absence of fever and cough will differentiate the condition from subglottic laryngitis, which is attended by inspiratory dyspnoea only and by some secretion. Bilateral paralysis of the abductors, with somewhat similar symptoms, is rare in children. Tumors more often present evidences of progressive dyspnoea with vocal impairment.

Prognosis.—This depends on the age, the surroundings, and the interval between the attacks. Reid notes one hundred and fifteen deaths out of two hundred and eighty-nine cases.

Treatment.—This must be directed, first, towards relief from the attack, and, second, towards the removal of exciting conditions. Fresh air, removal of all constricting clothing, semi-recumbent position, drawing forward the tongue, cold compresses to the head, and hot applications to the feet and legs will all tend to relax the spasm and facilitate respiration.

A small dose of morphine and atropine by hypodermic syringe is the most efficient medication during the attack. Should the apnœa continue, and there be immediate danger of carbonic acid asphyxia, one may pass a catheter into the larynx, intubate, or perform tracheotomy. As soon as immediate danger is over, the stomach should be emptied by an emetic, such as apomorphine, ipecac, or similar remedy, and a high rectal injection of soapsuds or a dose of calomel or gray powder be given, to be followed in four hours by citrate of magnesia. The genital tract should be examined, as some of these disturbances may come from vaginal conditions or a tight prepuce. These measures should be followed by the administration of nerve sedatives, such as chloral, the bromides, etc. If the attack be only a slight one, chloroform inhalations may cautiously be tried. Other remedies which have proved of service are antipyrin, physostigma, and drugs of the latter class, and, according to some authors, musk seems to be of peculiar value as an antispasmodic. After the attack has completely subsided, attention must be paid to the general health, and tonics, such as iron, cod-liver oil, and the hypophosphites, should be systematically given, and special attention paid to bathing, clothing, habits, etc.

SPASM OF THE GLOTTIS IN ADULTS.—In this condition there is a seizure of both constrictors and dilators, the former predominating. Undoubtedly most of the cases are of reflex nature, and in adults the seizure is rarely fatal.

Etiology.—The list of causes includes the entrance of food, drink, foreign bodies, etc., into the larynx. Mild forms are often seen in the intralaryngeal manipulations of ordinary treatment. Reflex causes may be found in any of the mucous membranes of the air-tract higher up, or in distant organs, such as the genital tract, alimentary canal, etc. Any pressure on the efferent nerves of the part may excite it, and laryngeal crises, so called, are met with in some cases of tabes, meningitis, and similar conditions. Occasionally syphilitic and tubercular disease of the larynx may be accompanied by spasms, but here there is generally a preceding œdema.

Symptoms.—These are of the nature indicated, and occur most frequently at night and during sleep. The attacks generally last about fifteen seconds. There is no nocturnal periodicity of successive attacks, as with children.

Diagnosis.—The discovery of a lesion higher up will explain the reflex nature of some cases. Tabes is generally accompanied by other symptoms of the disease, such as changes in pupillary reaction, loss of knee-jerk, and the characteristic gait. Rarely the crisis is an initial symptom of tabes, and for a time these cases may puzzle the physician. The laryngoscopic image after the attack has passed may reveal a succeeding paralysis, and search should be made for a possible diseased condition of the nerve-centres or trunks.

Prognosis.—While the attack is very disquieting to the patient, a fatal result is rare. In a few instances tracheotomy has been required.

Treatment.—The patient should be put on a course of bromides, cold bathing, and a good hygienic mode of living. The bath must be used with some caution at first, care being taken that it is not too cold. Between the attacks the upper air-tract must be treated as each case may require. Internal treatment should consist of arsenic, zinc, phosphorus, etc.

CHOREA OF THE LARYNX.—This is a form of muscular incoördination in which there is a momentary closure of the glottis, followed by a sudden breaking through of the air pent up in the respiratory tubes below. As a result, the child (for most of the cases occur in childhood) has a constant barking cough, which, however, ceases during sleep. In the milder cases there is no difficulty in speech, though in severe forms it may be jerky and uneven. The disease is seen in its typical form in nervous girls at the time of the establishment of menstruation, though cases have been reported in adults.

Examination shows a normal larynx, the movements of which are perfectly free and unconstrained in the intervals between the attacks. When the latter come on, the vocal cords are suddenly and sharply approximated, to be separated in a second or two by a similar movement, and at this instant occurs the characteristic cough. The other muscles of the body should be carefully watched for choreic manifestations, which may occur in parts remote.

Treatment must be directed to the removal of any exciting cause of spasm in parts above. Internally, the systematic use of arsenic, carried to the point of tolerance, as in chorea in general, and hot sedative inhalations gives the best results. The vapor of hops upon which boiling water has been poured is perhaps as efficacious as any local sedative.

The nature of the foregoing malady is somewhat uncertain. Most neurologists are indisposed to regard the condition as a true chorea. Some laryngologists have looked upon it as an occupation neurosis, analogous to writer's cramp. In some instances the choreic movements seem to extend to the respiratory muscles of the chest and abdomen, while in others they are also manifest in the palate. Schrötter, who in 1879 first introduced the term laryngeal chorea, regards many of the cases later reported under that title as merely instances of nervous cough, and not true chorea at all. For the latest exposition of the history and present status of the question the reader is referred to a paper by A. Onodi.¹

DYSPHONIA SPASTICA.—As the name signifies, the spasm in this variety occurs only when an attempt is made to speak, at which time the phonatory muscles are thrown into a spasmodic state. It is sometimes called *aphonia spastica*, *speakers' cramp*, or *stammering of the cords*. The

¹ Fränkel's Archiv f. Lar., Bd. x. S. 31.

voice sounds like that of one trying to talk during a violent expiratory or expulsive effort, as in parturition or evacuation of the bowels. The spasm seems especially to affect the tensors of the cords and the respiratory muscles. The condition generally begins with progressive impairment of clearness of voice, to which the spasmodic character is soon added. The closure always affects the ligamentous portion of the glottis, while the portion between the arytenoids may remain partially open. If, upon the onset of the spasm, the patient persist in the attempt to talk, it may continue until cyanosis is produced, as in varieties of spasm already described. Bosworth calls attention to the fact that one cord may overlap its fellow and one arytenoid be projected partially in front of its opposite.

The cause of this condition has been variously assigned to hysteria, over-use of the vocal organs, various reflex influences, and even a central lesion. The condition is not a dangerous one, but very embarrassing to the sufferer, and treatment is not very satisfactory. Cases due to some ascertainable reflex may be cured by its removal. The list of remedial procedures includes absolute rest of the voice, galvanism applied to the larynx, tonics, and the cold douche to the head and neck. This latter effected a cure in a case of Schech's,¹ and massage of the larynx helped a case of F. I. Knight's.² But one case of this nature has come under the writer's observation.

LARYNGEAL PARALYSIS.—The motor nerve-supply of the laryngeal muscles comes from the pneumogastric, the superior branch sending a twig to the cricothyroid muscle, which receives also a partial supply from the inferior branch, the main motor nerve of the larynx. The most recent anatomical studies tend to show that the pharyngeal branch of the pneumogastric sends motor impulses to the muscle just mentioned through a communicating branch known as the middle laryngeal nerve. The motor twig of the superior laryngeal also sends some fibres to the arytenoid muscle. The superior and inferior nerves of each side communicate with each other both at the back of the larynx beneath the pharyngeal mucosa and on the side of the larynx under the ala of the thyroid cartilage.

About the year 1880 attention was called by Semon and Rosenbach, working independently, to the fact that in paralyzes of the larynx the abductor muscles were regularly the first and often the only muscles affected from central or from nerve-lesions. This is known as "Semon's law." Some years later Krause asserted that this apparent paralysis of the abductors was nothing but a state of contraction due to irritation of the nerve-trunks or centres of all the laryngeal muscles. The discussion on these two views has been long and the literature has be-

¹ Monats. f. Ohren., 1885, S. 1.

² Trans. Amer. Laryngol. Assoc., 1889, p. 67.

come voluminous. Suffice it to say that the view originally held by Semon is the one now generally accepted. Why the abductors more quickly succumb to paralyzing influences is not known. It has been shown that there are in the inferior or recurrent nerve separate branches to the different abductor muscles, but their position in the nerve does not account for the condition it is sought to explain, as they are not in the most exposed situation. It has also been suggested that the posterior crico-arytenoid muscles are exposed to injury from the passage of food and air, but this is mere conjecture. The greater frequency of abductor paralysis, however, is unquestioned, not only clinically but experimentally, for it has been shown that freezing, irritants such as chromic acid and inhalation of ether, and post-mortem changes affect the abductors first. The exact cause of this is not known. Grabower suggests that it may be due to certain peculiarities of the termination of the fine nerve-fibrils in the muscles. Another point long disputed is that of the origin of the motor fibres distributed through the laryngeal branches of the pneumogastric trunk. They have been thought to come from the upper portion of the spinal accessory, but the latest anatomical researches throw doubt on this view, and it is now generally admitted that the vagus receives its motor innervation through its lower filaments from the dorsal nucleus in the lower part of the floor of the fourth ventricle.

For the present status of the discussion concerning abductor paralysis the reader is referred to an article by Macintyre.¹

The lesions causing laryngeal paralyses may be central or local. It is very hard to demonstrate the connection between cortical lesions and laryngeal paralyses; medullary and bulbar lesions are frequently, however, exciting causes. Paralysis also occurs in tabes dorsalis, syringomyelia, tumors, and from the large number of causes, such as pressure, trauma, etc., which may affect the branches of distribution of the pneumogastric or the nerve itself at any point; hence this list must include all varieties of cervical tumors, intrathoracic growths, thickened pleuræ, aneurisms, consolidated lung, spinal disease, etc. Moreover, affections of the muscles or local neuritis may produce the same result. This neuritis may arise from toxin-poisoning in any of the bacterial diseases, from states of profound blood impoverishment, from certain parasitic maladies, and from a large number of medicinal substances, especially lead, arsenic, copper, frequently alcohol, and occasionally cocaine, atropine, and morphine. Paralysis also results from the local lesions of tubercle and syphilis. It is occasionally a reflex manifestation of pregnancy, disappearing after confinement.²

These various lesions naturally present symptoms in other domains than those of the larynx, according to their extent. Thus, one may observe

¹ Jour. of Laryngol., 1898, vol. xiii. p. 219.

² Przedborski, Arch. f. Lar., Bd. xi. S. 68.

accompanying disturbances of the facial nerve causing paralysis of the face, of the auditory giving rise to deafness and giddiness, of the glosso-pharyngeal producing anæsthesia of the pharynx and larynx and paresis of the pharyngeal muscles with dysphagia, palatal paralysis causing regurgitation of food into the nose, speech defects, etc. If the hypoglossal nucleus be involved, paralysis with atrophy of the muscles of the tongue may occur.

Diagnosis of such a condition must be made from a study of the associated symptoms, which will locate the lesion with reasonable definiteness. It need hardly be said that unless the central lesion be due to syphilis, in which instance therapy may lead to a diagnosis of the disease, the prognosis is hopeless.

SPECIAL PARALYSES.

Paralysis due to affections of the pneumogastric trunk or nucleus manifests itself in the same way as paralysis of the terminal branches, and does not require separate consideration.

Paralysis of the superior laryngeal nerve is followed by a loss of sensation in the mucous lining of the larynx, and, owing to its distribution to the cricothyroid and arytenoid muscles, occasions a loss of tension in the

Fig. 268.



Bilateral paralysis of superior laryngeal nerve. (Porcher.)

cords and a lack of approximation in their posterior portion. This condition has been observed after diphtheria, typhoid fever, enlarged glands beneath the angle of the jaw, and trauma. The great and immediate danger is the entrance of food into the larynx, causing suffocation, and later foreign-body pneumonia. This danger is even more imminent if the recurrent nerve be also affected. If both cricothyroids be involved, the cords will be relaxed and present a wavy outline (Fig. 268). If both superior nerves be com-

pletely paralyzed, the glottis is divided by the approximation of the tips of the vocal processes. Bosworth says, however, that he "knows of no lesion which will produce this curious appearance."

The diagnosis is made by the mirror's showing the characteristic glottic picture and by the absence of sensation on probing. The prognosis is unfavorable unless the lesion be due to diphtheria or some toxic influence the effects of which may gradually wear away. Treatment consists in the administration of strychnine, the use of electricity, massage, tonics, and, in bad cases, feeding with the tube.

Paralysis of the inferior laryngeal nerve (recurrent paralysis) is one of the forms most frequently seen. It will be remembered that, with the exception of branches of the superior laryngeal to the cricothyroid and arytenoid muscles, the entire musculature of the larynx is supplied by the

recurrent nerve. Any lesion, therefore, of this nerve is followed by partial or complete loss of motion on the affected side, for in such a condition the partial supply of the cricothyroid from another source is without avail (Fig. 269).

Etiology.—The paralysis may be due to a central lesion, but more commonly to a tumor pressing on the course of the nerve. The list of such growths is headed by aortic aneurisms and thyroid enlargements, but any intrathoracic growth may act in the same way. Certain cases are referable to the terminal neuritis following various fever poisons, diphtheria, the exanthemata, and influenza. Occasionally a mild type of the condition has followed an acute catarrh.

Pathology.—Degenerative changes occur in the nerve, beginning with granulation and fatty degeneration inside the neurilemma, followed by disappearance of the contents and by shrinkage. As a result of the trophic disturbance there ensues an atrophy of the affected muscles.

FIG. 269.



Right recurrent paralysis; position of cords in deep inspiration. Black perpendicular indicates median line of rima glottidis. (Porcher.)

FIG. 270.



Bilateral recurrent laryngeal paralysis. (Porcher.)

Symptoms.—If the paralysis be confined to one side, the voice becomes at first weak and later hoarse, vocal range is limited, and conversation fatiguing. The affected cord is generally in the so-called cadaveric position,—that is, midway between adduction and abduction,—with concave edges. After a while the sound cord crosses the median line to meet its fellow. As a result, the voice may gradually become clear unless undue demands be made upon it. In phonation, the arytenoid cartilage of the sound side passes slightly in front of its opposite. Dyspnoea is absent.

When both nerves are involved the voice is entirely lost, and only by the greatest effort is even a whisper produced. There is no true dyspnoea, though the breathing may be somewhat stridulous from the approximation of the tips of the arytenoids.

Diagnosis.—Diagnosis is made from the position of the cords. Care must be taken not to confound this form of paralysis with that due to

loss of power in the adductors, in which both cords are widely separated, owing to the unopposed action of the abductors. In the latter condition the cords are drawn to the sides of the larynx or, if less widely separated, show jerky movements on attempted phonation. The rima glottidis may be oblique.

Prognosis.—This depends on the nature of the cause and the possibility of its removal. Neuritis from certain fever poisons may easily be overcome. Cases due to aneurism, tumors, or central lesions vary according to changes in the exciting cause. If no improvement result in from six to eight months, the condition will probably be permanent.

Treatment.—All acute catarrhal conditions should be treated, and for the neuritis of fevers and diphtheria the usual tonics given, especially combinations of strychnine with phosphorus and arsenic. Aneurisms call for the iodides. Electricity keeps up the tone of the muscles until the restoration of nervous stimulation. On general principles it may here be said that faradism is to be preferred if it will cause muscular contraction; if degeneration has gone so far that it will not, the interrupted galvanic current should be tried. One electrode should be placed on the nape of the neck and the other over the front of the larynx, or one electrode can be put inside the latter and an endeavor made to stimulate individual muscles. This is not difficult and, under cocaine, not painful.

PARALYSIS OF THE ADDUCTORS.—Paralysis of the *interarytenoid muscle* most often occurs from simple catarrhal causes, or it may form one feature of a more composite paralysis. The cords show between the arytenoid cartilages an irregular gap due to their lack of approximation. According to the size of this triangular opening there is more or less aphonia. Treatment is along the lines previously indicated. Catarrhal cases generally promptly recover.

Unilateral adductor paralysis is very rare, and much doubt exists as to correctness of diagnosis in some of the reported cases. Hysteria and lead-poisoning are the causes commonly assigned. The main symptom is loss of voice in a varying degree, according to the quantity of air-waste. Examination shows the cord in a state of extreme abduction, and the picture may be hard to distinguish from recurrent paralysis. One must also exclude swelling of the crico-arytenoid joint, and the beginner may mistake for paralysis an overhanging and inflamed ventricular band. The prognosis depends on the cause, and the treatment is as before outlined.

True *bilateral adductor paralysis* rarely occurs. The cases reported under this heading are generally due to hysteria, in which there is a functional impairment without true paralysis. A larynx thus affected is styled by some writers an hysterical larynx, though there seems to be no intrinsic reason why the conventional list of causes of general laryngeal paralyzes should not be operative here. Other writers regard this

as a separate variety, giving to the hysterical larynx the name of hysterical aphonia. The appearance of the cords suggests to some extent that described under the heading of double recurrent paralysis, in that there are an imperfect coaptation of the cords on attempted phonation, air-waste, and partial or complete loss of voice. There is, however, no loss of true respiratory movement,—*i.e.*, no absolute lack of motion. Another point to be borne in mind is the fact that, although patients cannot carry on conversation in ordinary tones, they can speak in a measured, emphasized, singsong way, and can in some cases sing fairly well; or, on the contrary, as in a case reported by Porcher, they can converse well, but are unable to sing or to preach and read a service. Careful examination should be made in these cases for other manifestations of hysteria. The prognosis is fairly good, but relapses are frequent. Treatment is as before outlined. Sudden cold affusions to the neck have benefited some of these patients.

Unilateral paralysis of the abductors is the most common of the motor neuroses, but its cause is often undiscoverable. It may give no symp-

FIG. 271.



Paralysis of the interarytenoid muscle.

FIG. 272.



Unilateral adductor paralysis; position of cords in attempted phonation.

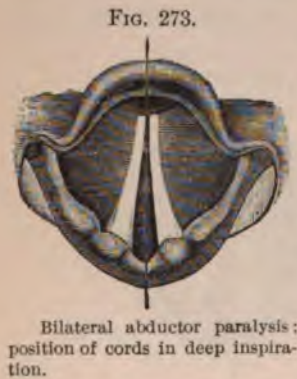
toms whatever, and be discovered only during a routine examination, which shows the cord immovable in the median line. Many cases are referable to an aneurism or intrathoracic growth, but the majority to a central lesion, and the Röntgen rays will sometimes solve the mystery of their origin. The remarks previously made as to prognosis and treatment apply equally well here.

Bilateral Paralysis of the Abductors.—The true nature of bilateral paralysis of the abductors has been much discussed. The muscles affected are the posterior crico-arytenoids, which separate the cords and are in constant respiratory activity, though the movements of the cords in quiet breathing are not always evident to the eye. These muscles are situated in a relatively exposed portion of the larynx. From these reasons, and perhaps from a special proclivity not yet understood, they seem to suffer damage more often and more easily than the adductors. The same gen-

eral causes apply here as in other forms of paralysis. Examination shows the cords in practically the phonatory position, and the voice, therefore, in ordinary conversation is but little, if at all, affected. In some instances only the anterior portions of the cords are approximated, and dyspnœa and stridor are present, both more marked in inspiration and during sleep. Forced inspiration, as during severe exertion, is very difficult. Paralysis of associated tensors, and possibly of the interarytenoid, may give a triangular appearance to the glottis, the base being posterior. A condition somewhat resembling this in objective appearance is that due to adductor spasm, but in the latter condition the cords are not held rigidly; they waver more or less, so that the amount of adduction is constantly varying; in paralysis the cords are fixed. In sleep the spasm relaxes, but in paralysis the stridor becomes more pronounced.

Prognosis.—The condition is a grave one, as suffocation is liable to ensue, and patients must be warned of the gravity of the situation as soon as the exact nature of the neurosis is evident.

In some cases of rapid development the wearing of a tracheotomy tube has been followed by recovery, but it is obvious that these were due to some cause not necessarily irremediable. But little hope can be held out if the condition has lasted over several months, owing to muscular degeneration and possible changes in the crico-arytenoid joint. The condition may show itself suddenly, and, unless immediate relief is at hand, death ensues from closure of the glottis due to the unopposed action of the adductors.



Treatment.—The danger of suffocation requires the insertion of a tracheotomy tube, which may have to be worn throughout life. The proposal has been made to excise the vocal cords. Aphonia is, of course, the result in either case, but if the latter plan be followed the tube can in time be removed. Excision of the cords has its advocates and detractors. Section of the recurrent nerve, so as to allow the retraction from the median line to the cadaveric position, has been suggested and in one case successfully performed.¹ Various adjuvant topical measures may give some relief.

Paralysis of the Tensors of the Vocal Cords.—The most frequent variety of myopathic paralysis is that of the internal tensors, the internal thyro-arytenoid muscles, and is known as *paralysis of the tensors of the vocal cords*. These muscles lie immediately beneath the cords, and in one sense form a part of them. Vocal strain and local inflammation from any cause directly affect them. The paralysis is usually but partial.

¹ Geronzi, La Riforma Med., Palermo, July 6, 1899.

Symptoms.—These are connected chiefly with the voice alone, which, according to the severity of the affection, becomes weakened, hoarse, or whispering, or there may be complete aphonia. Often the conversational voice is scarcely affected, and the difficulty becomes manifest only on the patient's attempting a carefully modulated exertion, as in singing, when an impairment of range may be the most prominent feature.

Diagnosis.—The appearance of the glottis varies according as one or both cords are involved. The chink will have the form of a half or full ellipse, the edge of the cord being concave from the bellying upward by the current of air from below. This elliptical area extends from the anterior commissure to the posterior, but that of ericothyroid paralysis, it will be remembered, stops posteriorly at the vocal process. Moreover, the vocal bands become cord-like instead of appearing flat, as under normal conditions.

Prognosis.—This depends on the possibility of giving the vocal organs complete rest. If this can be done recovery will generally follow in a few days. Caution must be given not to attempt to treat these cases too energetically, especially those due to vocal strain. What they need is *rest*, and if their restoration to normal function is sluggish, stimulating applications, such as muriated tincture of iron and glycerin in equal parts, or weak silver nitrate solutions, may be given. The faradic current, applied by means of a wet cotton pledget on a laryngeal applicator, answers well. Internally, the familiar combination of strychnine, arsenic, and phosphorus may be given, with cold baths, massage, and the usual measures employed to restore impaired nerve-tone.

In addition to the foregoing definite forms of paralysis there are various combinations of them, so that the laryngeal image is often a puzzle on first inspection. The complicated musculature of the larynx and the various resultant appearances of the rima glottidis must be studied in each case.

LARYNGEAL VERTIGO.—In 1876 Charcot¹ described a series of cases in which there occurred a spasm of the larynx followed by sudden loss of consciousness, to which he gave the name "laryngeal vertigo." A further study of the condition has proved the incorrectness of this term.

The attacks are somewhat peculiar in that a person feeling perfectly well is seized with a sudden tickling in the larynx, becomes unconscious, and may fall, but, if he falls, almost immediately gets up and goes about his affairs as if nothing had happened, and apparently is not much the

FIG. 274.

Paralysis of right internal tensor.
(Poreher.)

¹ *Compte rendu de la Soc. de Biol. de Paris*, 1876, p. 336.

worse for his unusual experience. For some years the disease was looked upon as a rare condition; the literature of the last five years has, however, placed it outside the category of rare diseases, for many cases have been reported. In 1896 Getchell¹ was able to collate seventy-seven in all, and there are others on record since that time.

Etiology.—No one set of causes can be assigned. In many cases the larynx has apparently been in an absolutely healthy condition. Various abnormal states of the air-tract have been recorded. In many of the cases thus far reported some manifestation of the neuro-arthritic diathesis was seen.

The main interest centres about the theory of nerve disturbance employed to account for the phenomena observed. The affection has been called laryngeal epilepsy, and some cases have been attended by several of the characteristics of this malady. That true laryngeal epilepsy is possible is shown by the case of Sommerbrodt,² who in 1876 reported a case of a patient with a pedunculated laryngeal polyp, who suffered from true epileptic crises which permanently ceased upon removal of the growth. It is interesting to note that this same patient had fifteen years before a short series of epileptic attacks which were referred to a cicatrix on the dorsal surface of the right hand.

The theory generally accepted is that propounded by McBride,³ who based his opinion on experiments in which, unknown to himself, he had been anticipated by Weber in 1851. He found by sphygmographic tracings that during forced expiration with closed glottis not only did the pulse become much weakened, but that the tracing showed a rapid and continuous diminution of the upstroke. From this he reasoned as follows. The acts of coughing, hearty laughter, etc., consist of a deep inspiration followed by attempted expiration with closed glottis. In laryngeal vertigo, however, the closure of the glottis is complete, and the whole expiratory effort is felt through the air contained in the lungs, by the alveoli, the large blood-vessels in the thoracic cavity, and the heart itself. As a result, syncope or a tendency to syncope is produced, and almost at the same minute the spasm of the glottis relaxes and the attack is over.

The relation of the condition to asthma is of particular interest. This has been studied by Moncorgé,⁴ who reports nineteen cases, all but one of which were asthmatic. It is not surprising to find laryngeal vertigo, or ictus, as it is sometimes called, in asthmatics, for ictus is nothing but a laryngeal spasm, and asthmatics are spasmodics. Again, ictus may present itself as a latent form of asthma, but, according to present views, should be considered rather as parasthmatic.

¹ Boston Med. and Surg. Jour., November 5, 1896, p. 466.

² Berlin. Klin. Woch., September 25, 1876, S. 563.

³ Edinburgh Med. Jour., March, 1884, p. 790.

⁴ Ann. des Mal. de l'Oreille, 1900, vol. xxvi. p. 129.

Symptoms.—The outlines of a seizure have already been presented. Niel,¹ who accepts the theory of reflex cerebral inhibition set up by irritation of the endings of the superior laryngeal nerve, divides the cases into three classes, according to the degree of inhibition.

1. Momentary vertigo with a sudden mental blank, coming on and passing off so suddenly that the patient is scarcely conscious of it.

2. Loss of consciousness of some definite duration, say five or six seconds, the patient falling down, but quickly rising and going about his affairs as if nothing had happened, is characteristic of true laryngeal ictus. These attacks are generally ushered in by a "sense of tickling in the larynx, provoking some outbursts of spasmodic cough and immediately after the loss of consciousness, with redness of the face and sometimes partial epileptiform convulsions" (Charcot).

3. Sudden death. Undoubtedly some of these cases help to make up the large category of sudden deaths from unknown causes. This is a rare occurrence, but it does occasionally happen.² It has followed severe blows on the neck and cauterization and other instrumentation in the larynx. In the stage of ictus these cases do not present any evidence of dyspnoea. Niel admits that patients affected with grave organic maladies of the larynx, such as malignant tumors, tuberculosis, syphilis, stenosis, etc., suddenly die. He explains this fact by assuming a theory of the existence of a "cumulative irritation." This finally becomes so great that there is a sudden explosion upon the sensory nerves of the larynx, a corresponding reflex upon its motor filaments, a cessation of breathing, and a fatal result.

Diagnosis.—Many cases are mistaken for epilepsy, but there is no frothing at the mouth, biting of the tongue, involuntary micturition (though one instance of the latter has been reported), and subsequent mental impairment, as occur in true epilepsy.

Prognosis.—In spite of the many mild cases of the affection, its occurrence is always a matter of concern. Special precautions should be observed in reference to the employment of local anæsthesia of the air-passages before surgical intervention in patients supposed to be liable to this special neurosis.

Treatment.—This should be directed to the general condition of the nervous system. The usual combinations of iron, quinine, arsenic, and zinc should be exhibited. Strychnine is, according to Bosworth, contra-indicated, but hydrotherapy benefits in most cases. Careful search should be made through the upper air-tract for causes of possible irritations productive of spasm. The recurrence has been broken up by the cure of an hypertrophic rhinitis and the removal of an elongated uvula and other causes of irritation.

¹ Ann. des Mal. de l'Oreille, 1899, vol. xxv. p. 161.

² Schadowaldt, Arch. f. Lar., Bd. v. S. 246.

CHAPTER XIX.

DIPHTHERIA.

DIPHTHERIA is an acute infectious, contagious disease, having its local manifestations by preference in the upper air-passages, but it may appear on any mucous membrane, at any mucocutaneous junction, on skin deprived of its epithelium, or on wounds. In the light of present knowledge the name should be restricted to "those cases of sore throat in which a false membrane is found, and in which a culture taken from this membrane or near it shows the presence of the bacilli of diphtheria, or to those cases in which there is a profuse nasal discharge, a culture from which shows the presence of these organisms" (McCollum). This caution cannot be too strongly insisted on. Such a term as diphtheritic sore throat should most emphatically be given up, for, while it does not mislead the physician, it often lulls the laity into a false sense of security and leads to deplorable results. So also the term membranous croup falls under the ban. The experience of recent years has conclusively shown that practically all cases of laryngeal stenosis due to false membrane are the product of the bacilli of diphtheria, and that while various other micro-organisms may give rise to membrane formation, the latter is rarely sufficiently dense and thick to cause respiratory danger.

Etiology.—Perhaps no disease in the whole range of bodily ills has from the very earliest times been more carefully studied than diphtheria. All writers in all ages have dwelt upon the high potency of its contagion. The establishment of the germ theory of disease concentrated ideas as to the nature of its exciting cause, but it was not until the year 1875 that Klebs was able definitely to isolate the bacillus of the disease. His views did not meet with general acceptance till 1883, but in the year following they were confirmed and amplified by Löffler. In 1888 Roux and Yersin were able not only to experimentally reproduce the disease, but succeeded in inducing in animals the paralyses and other toxic manifestations which had always been matters of clinical observation. From this period dates the present conception of the exact etiology of this affection. The great majority of physicians now accept the foregoing views, believing that diphtheria is caused by the Klebs-Löffler bacilli, and by them alone, and from this stand-point the present chapter is written.

The old idea of diphtheria without membrane is now pretty well abandoned. It is not always possible to locate the membranous deposit, which is not uniformly confined to areas open to inspection, and cases have been seen which resulted fatally, with every symptom of toxic sys-

temic poisoning, in which autopsies have shown only minute membranous patches.

It is quite possible that cultures taken from the mouths of healthy persons who have been brought in contact with diphtheritic cases may show the presence of the bacilli; but such persons are not to be regarded as having diphtheria, though it is possible that, by careless expectoration, kissing, etc., they may be the carriers of contagion to others. So also not every case of laryngeal diphtheria presents visible membrane, nor are culture experiments always positive; yet autopsies in these same cases have revealed the existence of the malady, and in some instances bits of membrane have been coughed up during life.

The Bacillus.—The Klebs-Löffler bacillus has about the length of the tubercle bacillus, but twice its thickness. Atypical forms are not uncommon, some having a granular appearance and a club-shaped enlargement at one or both extremities. Rarely the whole bacillus may assume a curved shape; the size may also vary greatly, and the outline is generally irregular. Certain well-defined spots may be brought out along the axis by staining with the Löffler alkaline methyl-blue solution.

Culture Test.—For practical clinical purposes the culture test is the one usually made. In nearly all our large cities there are either municipal or private laboratories to which the practitioner who is not a bacteriologist may send the culture outfit after it has been inoculated. The outfit consists, in its simplest form, of two tubes. The smaller one contains a sterilized swab made by winding a bit of cotton around the end of a stiff wire, the tube being plugged with a stopper of the cotton, and the whole sterilized by heat. In a larger tube is a bevelled layer of a culture-medium. That used by the New York City Health Board at present has the following composition: beef serum, three parts; nutrient bouillon (containing one per cent. of glucose), one part. The test is considered unreliable if an antiseptic has been used in the mouth within two hours of the inoculation. The swab is withdrawn from the tube, rubbed over the site of the diphtheritic deposit, and then smeared carefully and thoroughly over the culture-medium in the larger tube, the latter being inverted so that no contamination settles in it while the test is being made. The tube is then restoppered and returned to a collecting station, whence it reaches the laboratory and is placed in a thermostat at from 33° to 37° C. overnight. The results are generally determinable by noon of the next day, and in cities a notice is mailed to the physician. Of course, such a test is not always necessary, for there are many cases of diphtheria in which a single inspection of the throat is quite sufficient to establish the diagnosis; but, on the other hand, if one accepts the definition of the disease as laid down in the opening paragraphs of this chapter, there are doubtful cases in which one's own experience may lead him to decide in favor of or against a diagnosis of diphtheria, and in which a bacteriological diagnosis alone can lead to positive conclusions. Many epidemics of so-called

simple sore throats have doubtless been due to mild, though unrecognized, forms of diphtheria. This matter will be alluded to farther on.

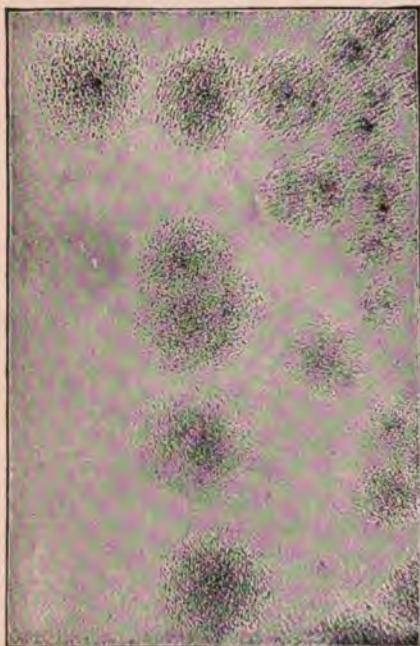
Predisposing Causes.—While the disease may attack adults, the vast majority of cases occur in early childhood. Infancy, however, is to some extent exempt. Shurly enumerates as causes of this exemption, first, the slight opportunity for infection; second, the antitoxic properties of the blood of infants, as proved by several observers; and, third, the absence of catarrhal conditions of the upper air-passages. Diphtheria occurs at all seasons, though less often in the summer, perhaps for the reasons that the comparatively out-door life at this period and the free ventilation of living-rooms by open windows and doors render the conditions less favorable for the propagation of the poison. Diseases of the upper air-passages offer favoring conditions for the malady, especially enlargement of the faucial and pharyngeal tonsils, for the diseased crypts of these structures furnish excellent culture-media. So also are to be included in the list of predisposing causes neglected oral hygiene and the depressing effects of other diseases, especially the exanthemata.

Concerning the effect of bad hygienic surroundings, and especially defective drainage, it may be said that, while all these conduce to attacks of ordinary sore throat, and thus furnish a suitable soil for the propagation of all sorts of pathogenic micro-organisms, they do not directly originate diphtheria. Strict isolation and modern hygienic methods will check an epidemic anywhere. The attendance at school of children suffering from mild but overlooked attacks of the disease is a common method of disseminating it; a similar result follows the resumption of school attendance by children who have convalesced and appear perfectly well, but in whose mouths the germs yet linger. Epidemics have arisen in new communities where it has been impossible to trace the source of infection. McCollum says that "it is now generally considered that imperfect drainage and unsanitary conditions should not be considered important factors in increasing the frequency of this disease."

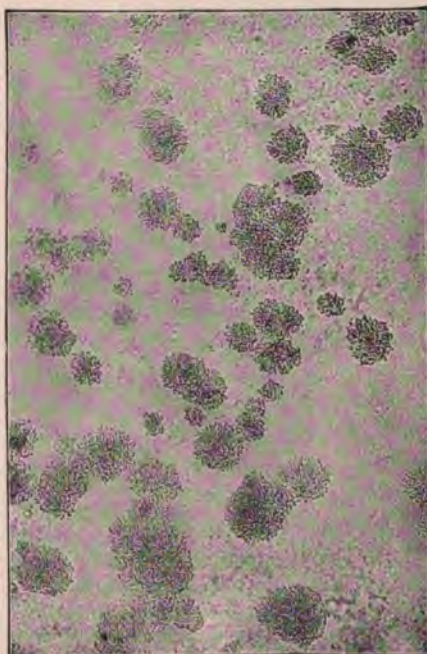
The disease is often spread by milk contamination and by infection from various domestic animals subject to it. Most cases of so-called diphtheria in the lower animals are due not to the Löffler bacillus, but to other organisms. The period of incubation varies from a few hours to fourteen days (Jacobi), according to the receptivity of the system, the average being probably from four to seven days. A patient seldom suffers from a second attack within a short period, the cause of this immunity being, according to Park, but imperfectly understood.

Pathology.—Diphtheria may be looked upon as essentially a local disease producing a poisonous material which is absorbed into the circulation and causes the characteristic symptoms. Most cases begin in the throat, where the germ first makes impact and where the conditions are especially favorable for its development. The coexistence of heat, moisture, bits of decomposing food, organic *débris*, etc., affords

PLATE XIII.



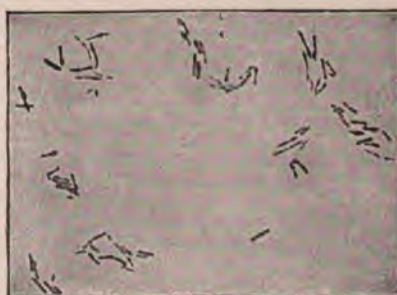
Colonies of diphtheria bacilli on agar. $\times 120$ diameters.



Colonies of pseudodiphtheria bacilli. $\times 120$ diameters.



Colonies of diphtheria bacilli on agar. Actual size after eighteen hours' growth.



Characteristic diphtheria bacilli, showing irregularity of form and staining.



Culture outfit. Box, sterile swab, and tube of blood-serum.

opportunities for the development of the bacillus. A false membrane is formed on the tonsils, faucial pillars, uvula, palate, or pharynx, and may extend in various directions. As a rule, it is of a grayish-white color, spreading from the original deposit, and so adherent that its forcible detachment leaves a bleeding surface. Sometimes it is of a milky-white color and for a while can be removed without bleeding. It forms first in the superficial layers of the mucosa, gradually extending to the deeper portions. It must be remembered that there are many false membranes due to various causes and not characterized by a specific germ, but by a collection of germs; so that, as before stated, the mere appearance of a false membrane is no sure sign of diphtheria. The Klebs-Löffler germ, when present, is more apt to be found in the superficial layers of the exudate, while the various other organisms—staphylococci, streptococci, etc.—are more abundant in the deeper layers, though found in all.

The membrane may extend to the nasopharynx and the nose. From the profuse nasal discharge which generally characterizes the latter form there may be an infection of the eyes causing intense conjunctivitis, swollen lids, and at times a membranous deposit on the conjunctiva. False membrane in the nose occurs by preference on the turbinated bones; the middle ear may become involved by extension through the Eustachian tubes, and downward extension may occur, even into the finer ramifications of the bronchial tubes. Of internal organs, the poison most commonly impresses itself on the kidneys, which are enlarged, with swollen cortex and degeneration of the epithelial lining of the convoluted tubules. The heart often shows evidences of fatty and granular changes. The latter are not especially noticeable to the naked eye, though easily revealed by the microscope. Nerve degeneration is very common, the cervical lymph-nodes are regularly enlarged and tender, and the blood shows a leucocytosis which progresses and diminishes with the course of the disease, and is, in a general way, an index of the gravity of the situation. The red cells are diminished in number and in hæmoglobin percentage, and hemorrhages in the skin, mucous, and serous membranes are possible.

The Toxin.—As a rule, the growth of the bacilli does not extend beyond the site of inoculation, but the toxin there produced is taken up by the circulation. Park notes that the bacilli may find conditions favorable for growth, but not for toxin production. It is doubtless owing to this fact that there are some cases of abundant membrane formation with but few constitutional symptoms.

Injection of toxin in animals will produce all the symptoms of the disease except the membrane formation. Various views are extant as to the exact nature of the toxin. Some have regarded it as an enzyme, others as a toxalbumin, assigning it to the class of globulins. Its exact chemical composition is still a matter of conjecture, as no definite analysis has been made. Lennox Browne holds that the toxins do not all

originate in the membrane, nor do the albumoses (resulting from the action of the enzyme on the body proteids) merely accumulate in the tissues; but probably the digestion of the body proteids by the action of the enzyme absorbed from the membrane forms the toxins.

Symptoms.—These may manifest themselves rapidly or slowly. All variations are found, from a prodromic period of general malaise with a non-distinctive sore throat up to a fulmination of symptoms which may prove fatal in twenty-four hours from the initial outbreak. Ordinarily the patient (usually a child) complains of sore throat, which, on inspection, appears hyperæmic or may present a patchy discoloration. The lymph-glands at the angle of the jaw may at this period be somewhat swollen and painful, and swallowing is rather difficult. The general symptoms are lassitude, stiffness of the muscles, especially about the neck, nausea, vomiting, and constipation, but the initial fever is not high. The force of the symptoms at this period is measured by the virulence of the infection. The younger the patient the more likely is the onset to be sudden.

In the presence of such a history as the above the physician will naturally at once examine the throat. Incidentally it is to be borne in mind that the initial throat symptoms of diphtheria are often not so severe as those of a simple lacunar tonsillitis. Inspection commonly shows a general reddening, with perhaps on the tonsil a small grayish or whitish-gray patch which quickly enlarges, or there may be different spots which coalesce. Extension of the membrane is apt to be along the faucial pillars, palate, and uvula. False membrane in the latter situation is far more common in diphtheria than in the various membranous deposits mistaken for it, which are generally on the convexity of enlarged tonsils. Initial symptoms may appear in the larynx in the form of stridulous breathing and cough, with evidences of more or less obstruction, or the larynx may become involved later by extension or secondary infection, the latter occurring about the seventh day. Extension of the membrane in other directions, as above indicated, will give characteristic local symptoms. The thickness of the fibrinous deposit in any of these situations varies from a thin film to a dense, hard, and thick membrane. It grows softer as the case progresses, and may be detached. Normally, detachment begins at the edges, which curl up, and the patch thus peels off. There is an increase of pharyngeal mucus, that, owing to the local conditions in the throat, is removed with difficulty. Meanwhile the absorption of toxic material goes on, producing general swelling of the glands of the neck, a temperature that, unless some complication supervenes, rarely rises above 103° F., and a rapid pulse-rate, to which the most careful attention should be paid. The pulse is perhaps the best index of the extent to which the system has become poisoned. It is regularly rapid in the disease, and an irregularity, especially associated with a slowness of action, is of most unfavorable import.

In about one-third of the cases there is renal disease, as shown by the presence of albumin, with hyaline and epithelial casts, and the urea and urates are increased by the fever. As the kidneys seem to be very susceptible to the effect of the poison, these symptoms appear early, as soon as the third or fourth day. The quantity of urine excreted at this stage is rarely diminished and may be increased, but hemorrhage is rare. The foregoing indicate intense congestion of the kidney. If actual nephritis occur, the urine becomes scanty, while hyaline and granular casts are found. Red blood-cells make their appearance, and the patient suffers from œdema, together with the usual uræmic manifestations. A rather curious fact is recorded by various observers,—namely, that in uræmic poisoning in diphtheria the mental faculties retain their clearness, even in fatal cases, to the end of life. Vomiting may occur, together with great nervous excitement, but at other times the patient will lie in a state of semi-coma.

The foregoing, excepting the uræmia, are the ordinary features of a straightforward pharyngeal case. The turning of the tide seems to come at about the end of a week, when in favorable cases the membrane begins to loosen and is expectorated; the urine clears, fever subsides, heart-action becomes more natural, and convalescence is fairly established. Soreness in the throat is apt to remain for several days after the mucosa becomes clean, and, as is now known beyond a doubt, the bacilli remain for weeks, during which period the patient is a source of possible contagion to others. Even after the mild cases have run their course there are various sequelæ which may prolong the disease for an indefinite time. In the unfavorable cases the fever remains high, the pulse becomes progressively rapid and feeble, the skin cyanosed, moist, and clammy, and the mind blunted, the degree of all these symptoms varying according to the extent of sepsis.

Nasal Diphtheria.—This has always been considered one of the most fatal forms of the disease, but researches of recent years have led to a modification of the views in this respect. In some of the cases in which cultures reveal the Löffler bacilli the constitutional and local symptoms are mild and the patient not very ill, recovering without any special difficulty. There occur cases of membranous exudation in the nose due to other micro-organisms, the disease being called membranous rhinitis.

Laryngeal Diphtheria.—Many cases begin in the larynx, and the most careful inspection will reveal no membrane in the throat. The bacilli are there, however, as will be shown by a culture test. These are the cases formerly known as membranous croup,—a name which is likely soon to pass from medical nomenclature. In these cases the pharynx is red, injected, and dry in contrast with the more œdematous condition common to many of the acute pharyngeal inflammations. The early occurrence of dyspnoea at once draws attention to the larynx, and unless relieved by treatment the symptoms become steadily worse, breathing

is stridulous, cyanosis develops, with a rapid and feeble pulse, and the patient dies of carbonæmia. In some cases a rash develops very much like that of scarlatina. It may come out on the second or third day, but more commonly does not appear until the second week. If the patient have been exposed to the poison of scarlatina, some doubt may exist as to exact diagnosis. There is no reason to doubt that the two diseases may coexist, but it is also true that a rash may be present in diphtheria alone.

Lacunar Diphtheria.—Koplik¹ has called attention to a class of cases in which the clinical features of the disease are not typical, membrane rarely present, and the diagnosis between diphtheria and simple angina extremely difficult and to the naked eye practically impossible; yet cultures have promptly shown the presence of the Löffler bacillus. These cases are, however, capable of infecting fresh throats, and of producing in them diphtheria with characteristic false membrane. So also cases resembling in microscopical appearances ordinary lacunar tonsillitis have been shown to be true diphtheria. These facts emphasize the double importance of bacteriological diagnosis and of isolation of all cases of sore throat, no matter how simple in appearance.

Complications and Sequela.—As has been said, any mucous membrane may be the seat of diphtheritic deposit, with corresponding symptoms; but the process rarely extends forward from the fauces to the anterior oral cavity, and deposits in the digestive tract are also unusual. The respiratory system is more frequently invaded, and the deposit may extend to the ramifications of the smallest air-tubes, presenting one of the most fatal types of the disease, for no mechanical relief is possible. Or, again, the lungs may not be invaded by the deposit, but may be the seat of a pneumonia. The lesions of the kidneys have already been spoken of, and, while in favorable cases they usually disappear, the foundation may be laid for permanent renal changes. All these are probably due to local attempts at elimination of the poison. Next in frequency to the kidney lesions are those in the nervous system, from which nearly all patients suffer to some extent. The most common manifestation is paralysis, which comes on in from three to four weeks after the cessation of acute symptoms, and most frequently attacks the soft palate, less frequently the muscles of the pharynx, and still less often those of the larynx. It may succeed those cases in which the symptoms have not been severe, the first evidence being impairment of the voice and regurgitation of fluids through the nose. The upper and lower extremities may also share in the paralysis, and least frequently of all the muscles of the eye. The danger of entrance of food into the larynx from the impairment of those muscles which preside over the initiatory stages of deglutition is at once obvious. It may be that semi-solids are

¹ New York Medical Journal, August 27, 1892, p. 225.

better controlled by the throat than fluids, which are extremely liable to run down into the larynx. Fortunately, diphtheritic paralyses, however severe, are generally recovered from, though persistent treatment is often necessary to bring about this result.

The paralyses of the extremities of trunk muscles are frequently preceded by disturbances of sensation, hyperæsthesia, or anaesthesia. Any or all of these may have a very contracted localization or irregular distribution. When the external muscles of respiration, and possibly the diaphragm, are alike involved, there are dyspnoea, short, dry cough, and labored, irregular breathing, and in such a case death may occur suddenly. Examination of the nerves and muscles in fatal cases has shown all degrees of parenchymatous degeneration, hyperæmia, and hemorrhages of both peripheral and central nervous organs. All these changes are the direct effect of the toxin of the disease upon the various structures.

The muscle whose involvement causes the most anxiety is the heart. Cases often die from heart-failure after they have apparently weathered the storm of the acute period. This heart-failure may be due to the direct toxic action of the disease-poison on the heart muscles, or to the formation of fibrin clots in the heart itself or in some of the great vessels. It may come on suddenly from the effect of some incautious movement in bed, or may be preceded by a weak and irregular pulse. Stenosis of the upper air-passages tends of itself to weaken and dilate the heart. Purulent inflammation of the middle ear is not uncommon.

Diagnosis.—The opinion has already been expressed in this chapter that in the light of present knowledge a bacteriological diagnosis alone can determine the existence of diphtheria, but there are many cases in which careful inspection and a proper analysis of the features of each case will make the diagnosis reasonably sure. It must not be forgotten that diphtheria was diagnosticated before bacteriology was thought of, nor must too much of the burden of decision in each case be thrown on the bacteriologist, for physicians have to act quickly and cannot wait for his findings. The mere presence of the Löffler bacilli in the mouth does not constitute diphtheria; there is also implied the existence of a group of constitutional symptoms indicative of toxic effects, and the local existence (most commonly in the throat, above or below) of a condition caused by the bacilli. Generally this condition takes the form of a fibrinous deposit, but, as has been seen, it is in rare instances wanting, or it may assume various unusual forms. Moreover, bearing in mind the minute details required in testing, culture-making, etc., it is evident that one negative result is not conclusive.

When called to a case, careful inquiry should be made as to the duration of symptoms, and any possible exposure to a disease in which sore throat has been a feature. If the patient be a child, say under seven or eight years, a suspicious case is far more likely to be diphtheria than if it occur in an adult. The patient should be carefully exam-

ined and the temperature taken. A sore throat which has begun with a high temperature is less liable to be diphtheritic than one in which the temperature has gradually risen. A similar remark may be made with reference to all local throat symptoms, as pain, odynphagia, etc. In diphtheria they are regularly of slower development than in many of the simple throat cases. The neck should also be searched for enlarged glands. The patient should then open the mouth, the tongue being pressed with a spoon, the latter to be put in boiling water immediately after using. In the present day the old-fashioned plan of carrying around a tongue-depressor in the pocket needs to be mentioned only to be condemned. A piece of wood splinting makes an excellent depressor, and can at once be destroyed. Observation should take in the buccal cavity, palate, faucial pillars, tonsillar surfaces, pharyngeal wall, and, if practicable, the mirror should be used to get a view of the nasopharynx and larynx. If a membranous deposit be seen, which on attempted removal comes away with difficulty and leaves a bleeding surface, it is due to some micro-organism, but whether that be the Löffler bacillus or not must be decided by culture test. In diphtheria the deposit is more likely to be on the uvula, edge of the soft palate or faucial pillars, or any sharp edge or projecting point rather than on a relatively smooth surface like that of the tonsil. If, in the absence of membrane, there be, in addition to the foregoing general symptoms, evidences of laryngeal involvement, and the physician be able to rule out an ordinary catarrhal croup, the presumption is strongly in favor of diphtheria. Finally, the rule may be laid down that in doubtful cases the patient must be isolated and treatment instituted as if the diagnosis of diphtheria had positively been made.

Differential Diagnosis.—Some of the points of contrast between diphtheria and other maladies with which it may be confounded have already been mentioned. It remains to be added that in scarlatina the exudation is generally confined to the tonsils, or at least does not, except in rare instances, appear on the fauces. Sometimes an apparent false membrane in this and other throat conditions is only tenacious mucus which has become spread evenly over the mucosa, but can easily be brushed off with a firmly wound cotton carrier and leave no bleeding surface. Naturally the appearance of the scarlatinal rash will decide the diagnosis, but it must be remembered that there are cases of scarlatina in which the rash is inconstant or even entirely wanting, except perhaps over very small areas and for a very short time, and it is in the earlier stages that differential diagnosis is so difficult. Subsequent paralysis may confirm suspicion as to the exact nature of a case which during its clinical course has been doubtful.

In measles there is rarely any false membrane, and the symptoms of the accompanying coryza, with the appearance on the fourth or fifth day of the catarrh and of the characteristic rash, or the earlier appearance

of the peculiar buccal eruption (p. 695), make the diagnosis easy. The tendency of measles to involve the entire air-tract, and its characteristic cough, are also of service in helping to a decision.

The so-called acute glandular fever of children presents some of the constitutional and some of the local external symptoms of diphtheria, but inspection of the fauces shows no exudation. Students occasionally mistake the deposits of *leptothrix mycosis* for diphtheria, but there are here no constitutional symptoms, and examination of the deposits with the probe will at once reveal their true nature.

The differential diagnosis from the various forms of tonsillitis has been sufficiently dwelt on. Non-diphtheritic deposit is less apt to become necrotic and give off a fetid discharge.

True and False Diphtheria.—The systematic and extensive culture examinations of the last few years have shown that there are bacilli identical in appearance with the Löffler bacilli and yet harmless, as they seem incapable under their usual conditions of producing toxin. There is still another organism having a habitat similar to that of, and resembling, the Löffler bacillus in some respects, but differing in others. Park notes that it is rather short, plump, and more uniform in many particulars than the true diphtheria bacillus. They are found in varying abundance in about one per cent. of normal nose and throat secretions; apparently they have no connection with true diphtheria, and their exact source is unknown. To them the name "*pseudo-diphtheria bacilli*" has been given. The term false diphtheria is anatomical rather than otherwise distinctive, and refers to the exudations found under various conditions.

Mixed Infection.—As has been stated, culture tests reveal an extensive flora in most cases of diphtheria. The most common organisms are the streptococcus, staphylococcus, and pneumococcus. It is to the presence of these that the various unusual clinical manifestations of diphtheria are largely if not wholly due. The action of antitoxin on a case of pure culture diphtheria of the Löffler bacillus can be predicated with great constancy, but not so if there be an association with the organisms above mentioned. The two former are the cause of the distinctly septic features of the disease, and the latter of the broncho-pneumonia so often complicating it. It seems to be true that "when other bacteria are associated with the diphtheria bacilli they mutually assist one another in their attacks on the mucous membrane, the streptococcus being particularly active in this respect, often opening the way for the invasion of the deeper tissues or supplying needed conditions for the development of their toxins. Thus, diphtheria is not always a primary, but often a secondary disease following some other infection, as measles or scarlet fever. In most fatal cases of broncho-pneumonia following laryngeal diphtheria there are found not only abundant pneumococci or streptococci in the inflamed lung areas, but also in the blood and tissues of other organs."

As these infections are in no way influenced by the diphtheria antitoxin, they frequently are the cause of the fatal termination (Park). Baumgartner (quoted by Shurly) insists on the essential identity of croupous and diphtheritic inflammations.

Prognosis.—The mortality of the disease varies greatly, being high in some epidemics and low in others. The mortality-curve for a long series of years shows alternate rises and falls. It is said that the years in which antitoxin treatment has been carried out have been synchronous with a natural depression of the curve, and that to this fact rather than to the curative powers of the remedy has been due the lessened mortality of very recent years, but time alone can prove or disprove the truth of this statement. The more nearly the bacteriological development in a given case approaches to a pure culture of diphtheria bacilli the more likely, of course, is it to recover; hence the use of the antistreptococcus serum may become supplemental to that of the diphtheria antitoxin. The younger the patient the more unfavorable the prognosis, and while both sexes are affected alike, statistics show (Jacobi) that the mortality is greater in boys than in girls. The outlook is better when the process is circumscribed and confined to areas with relatively scanty lymph supply. Laryngeal cases are more fatal than those in which the process is limited to the pharynx. But little can be predicted from the purely febrile features of a given case. Intermittence of the pulse, excessive swelling of the glands, evidences of severe renal implication, and especially pulmonary complications are always of the gravest import. The mortality varied from thirty to fifty per cent. before antitoxin was used. It now varies from ten to twenty per cent.

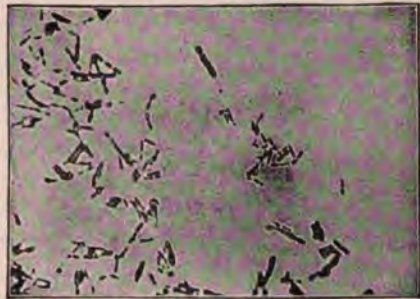
Treatment.—This may be divided into: (1) prophylaxis and (2) treatment of the disease.

Preventive measures may concern the patient's general environment or merely the local condition of his upper air-passages. General measures are comprised under the broad designation of sanitation, which includes the proper maintenance of water and sewage systems, free ventilation, disposal of house refuse of every kind, the establishment of a strict quarantine during the existence of a case of the disease, and the thorough disinfection of all articles which have been used about the sick-room. Municipal authorities in all our large cities require cessation of school attendance of well children in the family of the patient, nor are they readmitted until the teacher receives notification from the Board of Health that they may be allowed to come back. This notification is not given until a culture from the patient's mouth is free from bacilli and the premises have been disinfected. Until these are accomplished the authorities look on the case as a source of possible contagion. Under the heading of quarantine, the duties of the physician in regard to personal disinfection, change of clothing, cleansing of hair and beard, etc., must never be forgotten. For mouth-washes to be used by the well members

PLATE XIV.



Diphtheria bacilli, showing irregular form, but unusually even staining. Many xerosis bacilli have a similar appearance.



Characteristic diphtheria bacilli, showing very long and irregular forms.



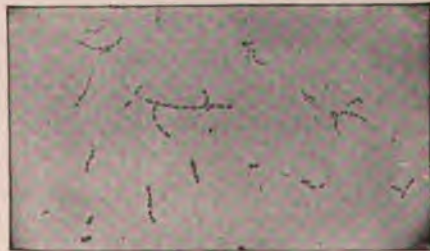
Pseudodiphtheria bacilli with a few diplococci.



Pseudodiphtheria bacilli with a few diplococci.



Streptococci and diplococci from a culture growth on blood-serum from a case of pseudodiphtheria.



Streptococci and diplococci as seen in a smear made directly from the exudate in a case of pseudodiphtheria.

of a household in which the disease exists many antiseptic remedies have been suggested, but any one, thoroughly used, is doubtless good. Perhaps for a gargle resorcin in a five per cent. solution is the best. For use in the nose and nasopharynx with the coarse atomizer, douche-cup, or syringe, preparations of the listerine type, one teaspoonful to a glassful of lukewarm water, are to be recommended.

During the intervals between epidemics, or as soon as circumstances render it prudent, an endeavor should be made to place the upper air-tract of children in a normal condition. Enlarged tonsils should be excised, catarrhal states remedied, and all conditions which favor the development of contagion removed. When once the disease is fairly established the question of throat disinfection immediately arises, and nearly every antiseptic in vogue has been suggested. Perhaps hydrogen dioxide diluted with twice its volume of lime-water is as useful as any, and it should be followed by a solution of mercuric bichloride (1 to 4000). In young children there may be substituted for the bichloride a listerine solution, a teaspoonful to four ounces of water, and such application may be made every two hours.

The mode of applying these remedies must be determined by circumstances. If the patient be old enough to gargle, they may be so used, but the condition of the heart often renders it extremely dangerous to make the exertion necessary for gargling. Therefore the physician should resort to sprays or irrigation of the mouth, the patient lying on his side at the edge of the bed. For very young children probably the spray is the most practicable means. In regard to subsequent local applications, it may be said that they are permissible only when the patient is old enough to co-operate with the physician; to thrust the applicator in at random and swab it over the throat will do more harm than good. For topical use there may be employed the Löffler solution (p. 694), bichloride solution (1 to 500), pure lactic acid carefully limited to the deposits of membrane, perchloride of iron, strong silver nitrate (from forty to sixty grains to the ounce), a solution of zinc chloride (U. S. P.), menthol in a bland oil, half a drachm to the ounce, etc. Steam inhalations may be used, as in spasmodic croup, but they must not be continuous for fear of their depressing effects. The air of the sick-room may be impregnated with an antiseptic vapor, and of the many proposed none is more efficacious than the one so long employed by the late J. Lewis Smith,—viz., oil of eucalyptus and carbolic acid, of each, one ounce, and oil of turpentine, eight ounces; two tablespoonfuls of this mixture should be placed in a quart of water, which should be allowed to simmer near the patient, the containing vessel, such as an ordinary basin, having a broad surface so that the contents shall not take fire. In nasal cases the nose should be sprayed, but strong solutions here are hardly practicable, and the latter remark applies also to the larynx. With older children sprays can be used, but in any case the inspired

air may be medicated, and with a little care all benefits possible with this method can be obtained. The nasopharynx should be sprayed, and the various solutions, especially the Löffler toluol combination, be used on an applicator; but once again the caution is given that, unless the patient be fairly tractable, such measures are apt to do more harm than good. An ice-water coil over the neck is often grateful.

Diphtheria is now regarded as a local malady leading to systemic infection. The object of all the foregoing measures is to destroy the germ growth at the site of inoculation and thus prevent toxin formation. With the same end in view various solvents of false membrane have been tried at different times, such as trypsin or papain, a proteolytic ferment obtained from papaw milk (the juice of the carica papaya, a tree of South America), which will dissolve fibrin in a menstruum of any chemical reaction. The introduction of antitoxin has led to a general abandonment of these remedies.

Constitutional treatment should be commenced as soon as the case is seen. Those who believe in antitoxin therapy will, perhaps, not be particularly interested in other plans, but this remedy may not be available, and it is well in such a juncture to have a definite plan of procedure.

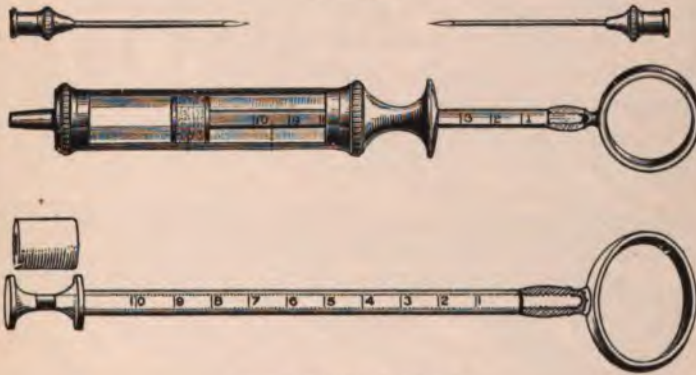
At the start the bowels should be moved by calomel, one-tenth of a grain being given every half-hour up to full and free catharsis. A bed-pan must be used and the patient kept recumbent, and from the very start care taken to save him every kind of exertion. The most popular remedy is muriated tincture of iron in glycerin; of this a child of five years may take ten minims every three hours during the acute stage. It undoubtedly strengthens the vital powers against the onset of the malady. There is no reason to believe that the time-honored combination with potassium chlorate is of any more benefit than the iron alone, and, moreover, the latter remedy is not devoid of danger, in young children at least. The mercurials may be given in small and continuous dosage, say one-one-hundredth of a grain of the bichloride every two or three hours. Small tonic doses of quinine and alcoholic stimulants to keep up the action of the heart, supplemented by digitalis, strophanthus, and especially strychnine, will all find their appropriate place. Calomel may be given by sublimation, especially in the laryngeal cases. From five to ten grains of the drug are placed in a pan over a protected spirit-lamp, and the whole placed under a crib covered by a tent. The quantity is renewed two or three times at intervals of from a half to three-quarters of an hour, the effect being carefully watched, so as to avoid salivation. If there be much mucus in the air-passages, one or two doses of atropine may be of service.

The constitutional remedy most in vogue at the present time is antitoxin, and the physician should employ the concentrated preparations,—that is, those of high antitoxin-unit strength per cubic centimetre. No preparation is reliable after an age of six months.

Immunization.—It is possible to employ antitoxin in immunizing those exposed to the disease. For this purpose an injection of from three hundred to six hundred units will prevent an attack for a period of two weeks. The injection must then, in case of continued exposure, be repeated. When the disease has fairly started a curative effect is still possible by preventing the continued action of the toxic principle. It is at once apparent that no effect is possible on tissues already damaged. Antitoxin is rather preventive of further bad results, and consequently should be used at the earliest possible moment. It seems to act not by a chemical neutralization of the diphtheria toxin, but by a re-enforcement of the natural resisting power of the patient, notably through the medium of the blood-plasma.

A good form of syringe for injection is the one shown in Fig. 275. The most scrupulous antisepsis should be observed, and care taken to

FIG. 275.



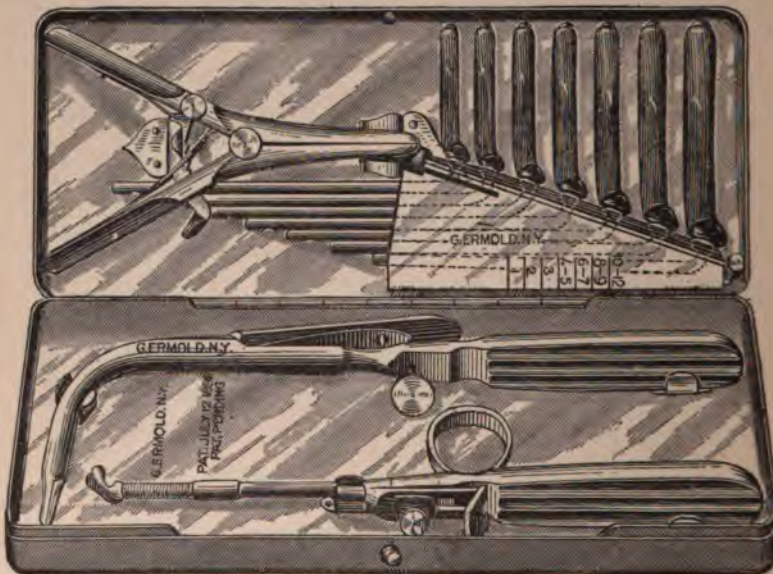
Ermold's antitoxin syringe.

exclude all air-bubbles from the barrel when it is filled. The injection should be made very slowly in the loose skin between the shoulder-blades or on the abdomen. The site should first be carefully washed with soap and water and then with an antiseptic solution. From one thousand to two thousand units should be employed, according to age and severity of symptoms, and the injection may be repeated in twelve hours. It is rarely necessary to exceed a total of six thousand units. As the fluid is quickly dispersed in the tissues, it is advisable not to rub the skin elevated by the injection, but to place a protective over the puncture for a short time. Pain at this site may be relieved by a hot-water bag or a cloth dipped in a warm saline solution. The possibly bad effects which follow injections can generally be ascribed to impure preparation or some fault in method. The urticarias which were so common, as were the joint troubles, after the injections of earlier days are now rarely seen. There is some reason to believe that they were due to the large quan-

tities of horse-serum used and not to the antitoxin elements. The good effects are often marvellous in their promptness, the membrane soon beginning to show a line of demarcation and curling up at the edges; the temperature falls, the pulse becomes slower and of better quality, and symptoms of depression vanish; in fact, the improvement is so rapid that it is often difficult to keep the patient quiet and in bed as long as judgment dictates.

In cases of laryngeal diphtheria in which, in spite of the antitoxin, the symptoms of laryngeal obstruction become increasingly urgent and the child cyanotic, with a small and infrequent pulse, the alternatives are presented of tracheotomy and intubation. The former has from the

FIG. 276.



O'Dwyer intubation set.

earliest ages of surgery been a well-recognized means; the latter had been attempted by various workers in former years, but it remained for O'Dwyer, of New York, to make it a practical matter, and so careful was his study of the question and his appreciation of all the pathological and mechanical problems involved that very little of essential value has been added to his original communications on the subject.

Herewith are figured the various instruments required in the operation. The child should be wrapped in a blanket, only the head being exposed, and firmly held by an assistant, who places the patient's legs between his own, the child's back being tightly held against the assistant's chest. Another assistant holds the head firmly in the median line. If

the patient be lying in bed, absolute quiet on his part must be maintained. The gag is placed between the molar teeth, and the operator then hooks forward the epiglottis with the left index-finger. The introducer, with the tube attached and threaded with braided silk, is then passed into the mouth, its handle being held at first well down on the patient's chest and the thread wound about the surgeon's little finger. As soon as the end of the tube is over the larynx the handle of the introducer is abruptly turned so as to render the tube vertical. The latter is now passed down into the larynx, the introducer (also called obturator) disengaged by forward pressure on the handle and removed, and the tube pressed down into position by the left index-finger. The thread is passed over the left ear of the patient and the gag removed. If the tube be properly inserted the patient coughs, giving a peculiar sound not easy to describe, but when once heard easily recognized again. The color of the child improves, breathing becomes easier, and it often at once falls asleep. If the tube be passed into the œsophagus, there is no relief to the dyspnoea, no peculiar cough, and the tube will begin to go farther down, as evidenced by the gradual disappearance of the thread, which can be used to remove it. If satisfied that the tube is in proper position, the operator reinserts the gag, places the left index-finger on the tube to hold it in position, and withdraws the thread, the loop having been cut. Cautions necessary are to keep in the median line, to be gentle in manipulation, to keep the back of the finger in contact with the posterior wall of the pharynx, forming, as it were, a continuation of it, and to make the sudden turn of the obturator so as to bring the tube into the vertical position. In removal of the tube the gag is introduced as before, the left index-finger placed on the tip of the tube, care being taken not to make pressure, the extractor introduced, and its jaws opened so as to engage the tube, the movement of extraction being the reverse of that of introduction.

If the tube happen to be swallowed, it will probably pass through the bowels without difficulty. If it be coughed out in a few hours, it must be reinserted if demanded by the symptoms. It is a good plan to remove it on the fourth or fifth day, even if immediate reinsertion be required.

The advantages of intubation over tracheotomy in diphtheria are: absence of a wound, freedom from shock, and the fact that air through the natural channels in the former method, even in diphtheria, is less liable to excite pneumonia than is air through a tracheotomy tube. In adults it seems that in diphtheria clinical results are better from tracheotomy than from intubation. But in general it may be said that the latter operation is gradually supplanting the former under the conditions named.

The diet in diphtheria should consist of liquid foods, such as milk, beef extracts, yolks of eggs, broths, etc., and should be given at intervals of from two to three hours. Orange juice is both grateful and permis-

sible, and ice-cream, if made from good materials, may be taken in small quantities. As soon as the membrane has cleared off sufficiently to allow semi-solid foods, jellies and custards, with soft animal foods and the cereals, may be added. The condition of the urine will to some extent determine the time of resumption of full diet.

The intubated child is obviously restricted to fluid food, which may be sucked up through a tube from a vessel lower than the level of the head, or the patient may lie on the back with the head lowered so that the pharynx is lower than the larynx (Casselberry position). Other methods are rectal enemata and nasal feeding, the latter being easily carried out with a catheter attached to a glass funnel by means of tubing. This method has the very great advantage of enabling the quantity of nourishment entering the stomach to be accurately determined.

The various complications are to be treated according to general therapeutic principles. In the cases of paralysis, strychnine must be pushed to full physiological effect and electricity carefully and systematically employed. Palatal paralysis may require nasal feeding, as above suggested.

CHAPTER XX.

THE PHARYNX AND LARYNX IN THE EXANTHEMATA AND OTHER FEVERS.

IN many of the exanthemata and other febrile conditions inflammation of the mucosa of the pharynx and larynx occurs so constantly, and at times assumes such severity, that it demands separate consideration. The most common affections in which this complication occurs are scarlatina, measles, r  theln, variola, varicella, typhoid and typhus fevers, malaria, and influenza.

Scarlatina.—In this disease the inflammation of the pharynx and larynx is most constant. Many persons who seem immune to the disease itself suffer from a sore throat when brought into contact with the scarlatinal poison. It is possible that such throats represent an abortive form of the fever. The throat symptoms regularly precede the appearance of the rash. The initial appearance differs in no way from that of an ordinary catarrh, but by the time the case comes under observation this stage has generally been succeeded by one of redness with swelling of the tonsils; more severe grades of infection show a diffused, brawny swelling of the parts, with perhaps a lacunar tonsillitis, or more commonly a distinct membranous exudation with enlargement of the submaxillary glands and even an induration of the entire cervical region. This initial invasion is due usually to streptococci, though staphylococci and bacilli coli communis have been found, and occurs, as a rule, before the end of the first week. In the second or third week there may be a complicating diphtheria with L  ffler bacilli. The gross appearance of the membranes does not distinguish one from the other, and a bacteriological test should be made in order to determine the proper therapeutic measures. After subsidence of these affections the lymphatics are often left inflamed, which inflammation may lead to serious consequences. The exudate may extend from the visible parts of the pharynx to any of the neighboring areas; later comes a clearing off with attendant ulcers, which soon heal, or gangrenous changes may occur. These severe forms of scarlatinal affection were formerly called “scarlatina anginosa,” and in such the throat symptoms are apt to overshadow all others. Occasionally there are a purulent infiltration into the deeper parts and various manifestations of sepsis, an occasional sequel being retropharyngeal abscess.

Similar changes affect the larynx, though less constantly, as evidenced by the fact that cough and hoarseness are not regular features of the disease. Generally the inflammation here is of a catarrhal nature,

though occasionally there may be œdema, membranous deposit, gangrene, and abscess with accompanying symptoms of laryngeal stenosis. Lennox Browne calls attention to the fact that in the renal complications of scarlatina there may be a condition of acute laryngeal œdema lasting weeks, or even months, after the subsidence of the fever proper.

Treatment.—The treatment of the throat complications of scarlatina is of the greatest importance, not alone as promotive of the patient's immediate recovery, but also as tending to the prevention of disastrous sequelæ which, while not necessarily dangerous to life, threaten bodily integrity in most important directions. The end sought is the prevention of secondary infection from the results of throat diseases. As soon as the existence of a sore throat is discovered, even before there is any definite diagnosis of scarlatina possible, a systematic disinfection of the pharynx should be commenced. At the same time the severity of the inflammation may be lessened by the application of cold to the neck, preferably by the Leiter coil; but if this be not at hand, ice-bags or even ice-cloths may be used. The choice of an antiseptic for throat cleansing is of minor importance, so long as the one selected is used thoroughly and systematically: it may be utilized as a gargle, in spray or douche, or may be applied topically. For very young children the spray is undoubtedly the best method, but an atomizer throwing a coarse spray should be used. For older children the gargle or the douche may be employed. The latter is very useful when the inflammation has involved the postnasal space or nose. When only the pharynx is involved, the child should lie on its side at the edge of the bed and a stream allowed to run in and out of the mouth under very low pressure, effected by having the level of the supply-bag but slightly higher than that of the bed. In case the inflammation involves the nose and nasopharynx, the nozzle may be placed in one nostril, the mouth being held open so that the stream will emerge from the other. Nasal douching is not free from objections, but if performed with the precaution noted, it is a most thorough method of cleansing. The child should, if possible, avoid swallowing, and if gently managed, will submit to the manipulation without trouble. In the manner outlined solutions of boric acid may be used, a drachm to the pint, salicylic acid in the same strength, or the listerine type of preparations in the strength of a teaspoonful to four ounces. In the atomizer equal parts of hydrogen dioxide may be employed, followed by some distinctly alkaline solution, such as Dobell's. Unless the general condition contraindicates, this should be done every two hours. With still older children, who can control the throat sufficiently well to allow topical applications, the dioxide may be used in full strength (the forms sold commercially as "pyrozone" have given the writer satisfaction), or the well-known Löffler iron-toluol solution, the formula of which is as follows: toluol, thirty-six parts; absolute alcohol, sixty parts; solution of the sesquichlorate of iron (old German Pharmacopœia), four parts; for

the latter may be substituted the U. S. P. liquor ferri chloridi. Thorough cleansing with an antiseptic solution and drying as far as possible by means of cotton pledgets should precede the topical applications.

All the foregoing, and especially the hydrogen dioxide, should be used with care. A distinct caution is given against the frequent application of too irritating solutions. More harm than good is thereby done, for areas may be denuded of their epithelium and further infection thus encouraged. If examinations of the membranous deposit reveal the Löffler bacillus, the physician should proceed at once as in diphtheria. In some cases of severe streptococcus infection the antistreptococcus serum has yielded good results.

Measles.—In measles the clinician may find a diffuse redness or a punctate blotchy eruption in the pharynx, with maximum distinctness on the soft palate, possibly on the tonsils or posterior faucial pillars. In some cases it antedates the skin eruption, some authorities going so far as to say that three days may elapse between the palatal and skin manifestations. There is constantly found a catarrhal condition involving the entire upper air-tract from the nose down to the trachea and larger bronchi, giving its characteristic symptoms, with the peculiar "iron" cough. These catarrhal symptoms usually last four or five days and are of an obstinate type, gradually lessening as the exanthema appears on the skin and subsiding with the disappearance of the eruption.

Mention may here be made of the so-called Koplik's sign, which, according to this authority, appears on the buccal mucous membrane from one to five days before the skin outbreak. The eruption is in the form of small, irregular, bright reddish spots, in the centre of which is a bluish-white speck. Ordinary manipulation does not remove them; they persist until the cutaneous rash is at its height, when they begin to disappear. Strong direct daylight is necessary for their detection, but it is held that this condition is absolutely pathognomonic of measles. All other spots on the throat in general are non-significant until suspicions are confirmed by the appearance of the skin lesion.

In the larynx catarrhal changes are, as has been indicated, nearly always present. They usually subside as the rash fades, and are, as a rule, not dangerous, though there occur at times spasmodic attacks with some signs of local obstruction, and intubation has been necessary. Ulcerative changes are uncommon, but have been observed, and in such cases the laryngeal symptoms become progressively worse, and death may result from cedema of the glottis. Membranous laryngitis in measles may be truly diphtheritic or due only to streptococci and other pyogenic organisms. This condition is not seen in private practice, but has caused terrible mortality in public institutions. The diagnosis may be difficult unless there be membrane in the pharynx. Before the true condition is appreciated broncho-pneumonia may have set in, and doubtless the membrane has already invaded the trachea and bronchi; hence the

surgeon has no means at his command to ward off the inevitable end. Gangrenous changes are possible, and glandular involvement will depend on the severity of the local lesions. For all the foregoing there is no special treatment. Systematic cleansing of the upper passages renders the lower much less liable to infection.

Rötheln (German Measles).—Some authorities find sore throats in not more than one-fifth of all the cases of German measles, while others believe that they are constantly present. There are no special appearances which are distinctly characteristic of the disease. A non-distinctive exanthema may appear on the palate for a few hours only. The tonsils swell usually in correspondence with the severity of the disease, which, as seen in the United States at least, is generally mild. Dysphagia is often quite sharply felt, and is rather out of proportion to the local appearance of the throat. An occurrence universally admitted as of general importance is the enlargement of the lymphatic glands at the angle of the jaw. Reed has reported a case in which the eruption appeared on the palate and tonsils alone, the skin being free. No special treatment is called for.

Variola.—The throat symptoms in variola may commence during the stage of incubation or that of invasion. The exanthema seems to reproduce itself in the mucous membranes, though modified by the structure of the latter. There may be simply a dusky injection of the parts, or the usual appearance of a catarrhal inflammation, which causes great irritation and is a feature of which the patients bitterly complain. In hemorrhagic small-pox there may be ecchymotic spots on the pharyngeal mucosa with the customary involvement of the lymphatics. In ordinary cases the typical eruption appears on the palate, tonsils, and often in the larynx and trachea, going through the regular papular, vesicular, and pustular stages, modified by the moisture and attrition of the surfaces on which it appears. In severe cases the localized deposits on the pharyngeal mucosa may be followed by a general tendency to suppurative processes. The secretion is thick and tenacious and is expectorated by the patient with great difficulty.

In the larynx the changes are more severe, and there may be either catarrhal, ulcerative, or membranous conditions. The laryngeal symptoms are apt to appear towards the close of the first week of the disease, and are of the customary variety, except that the cough appears unusually harsh and dry, and there may be severe and even dangerous dyspnoea. A whispering voice at this stage is regarded as a very bad sign. Naturally the development of a rash, such as that of variola, near the larynx may be followed by oedema of the organ. Ulceration with destruction and erosion of the various cartilages—even gangrene—may also be present. In a bacteriological sense true diphtheritic deposit is extremely rare. Browne reports the occasional fixation of one vocal cord from ankylosis of the crico-arytenoid joint, but denies the existence of any true muscular paralysis.

It is in the confluent and malignant types of variola that these more severe complications are to be expected, for in the milder cases not much trouble is experienced. Treatment consists of local antiseptics and sedatives, with such mechanical attention to the larynx as it may call for. Gargles of a weak solution of potassium chlorate or of some salt, as borax or baking soda, are grateful to the patient, and may be followed by the application of cocaine (caution with children) or menthol in glycerin (Kyle). The patient may be allowed free use of ice-pellets and bland and demulcent drinks, such as elm, flaxseed, acacia, etc. In case the patient is not able to gargle or rinse the mouth freely, a soft swab dipped in a solution of borax should be used several times a day, and a most vigorous attempt made to keep the upper passages well disinfected. The food should be bland and unirritating, soft jellies and iced milk offering the best dietary. Externally, ice-bags or the Leiter coil may be applied, for while they may not materially reduce the severity of the local inflammatory changes, they will greatly relieve the pain.

Varicella.—The physician should expect to find a rash on the pharynx and surrounding parts in varicella. By the time the case comes under observation there will be vesicles, which, owing to the attrition to which they are subjected, quickly break down, leaving aphthous ulcers surrounded by a well-marked reddish zone. They are most marked on the palate, the larynx rarely being involved, and when it is the case ends fatally. Treatment is along the lines previously indicated.

Typhoid Fever.—A certain degree of pharyngitis is almost always present in typhoid fever. It may assume a lacunar, follicular, ulcerative, or membranous, but rarely a diphtheritic type. Aphthous conditions of the buccal mucosa are always present. Swallowing is more or less difficult from the beginning, owing to the dryness of the throat, and later there seems to result, doubtless from the continued high body temperature, partial paresis from granular degeneration of the muscular fibre. Cases in which the local lesion expends itself on the lymphoid structures are to be regarded as analogous to the invasion of the intestinal lymph-nodes. In some instances there is a characteristic symmetrical ulceration on the faucial pillars. It presents itself as a shallow oval patch, the long diameter being vertical, slightly excavated, and covered with a greenish pellicle, which, however, is merely part of the buccal mucus, and is easily removed. The edges are sharply defined, and the patch may look as if punched out. André Schaefer,¹ who carefully studied nine of these cases, was not able to find the bacillus of Eberth on the surface, but only those micro-organisms commonly found in the mouth. The staphylococcus aureus was found in five out of the nine cases.

The laryngeal changes in typhoid are far more common and of graver

¹ Thèse de Paris, 1899.

As to removal through artificial channels, the principles of procedure are as follows. For large angular bodies in the larynx, where movement will lacerate the tissues, thyrotomy ; the only danger is possible impairment of voice. For small, smooth bodies impacted above the cords, so that they can be removed through the opening or pushed up through the mouth, incision through the cricothyroid membrane. For impaction of large bodies in the lower larynx or upper trachea, laryngo-tracheotomy. For bodies in the trachea or bronchi, and for all cases in children, a high or low tracheotomy, according to the position of the mass with reference to the isthmus of the thyroid gland. For bodies in the upper larynx so impacted that direct access is required, pharyngotomy (lateral or subhyoid).

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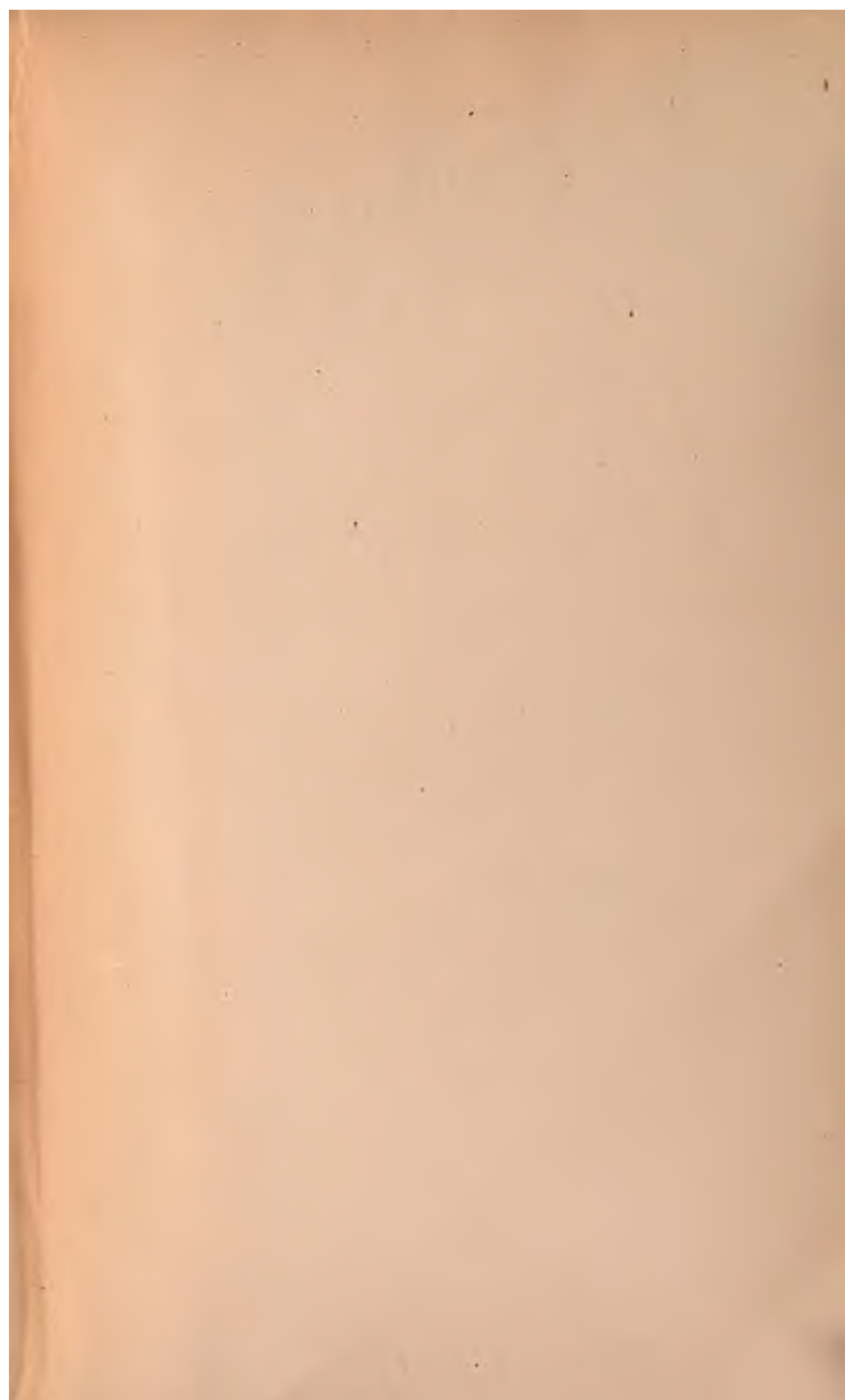
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